MAY 15, 1950

MODERN MEDICINE

The Journal of Diagnosis and Treatment

SYMPOSIUM ON FRACTURES

Dr. Edwin B. Plimpton
(see page 11)

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A good night's rest
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1. Sheldon, J. M. et al: Univ. Mich. Hosp. Bull. 14:13-15 (1948). 2. MacQuiddy, E. L: Neb. State M. J. 34:123 (1949)

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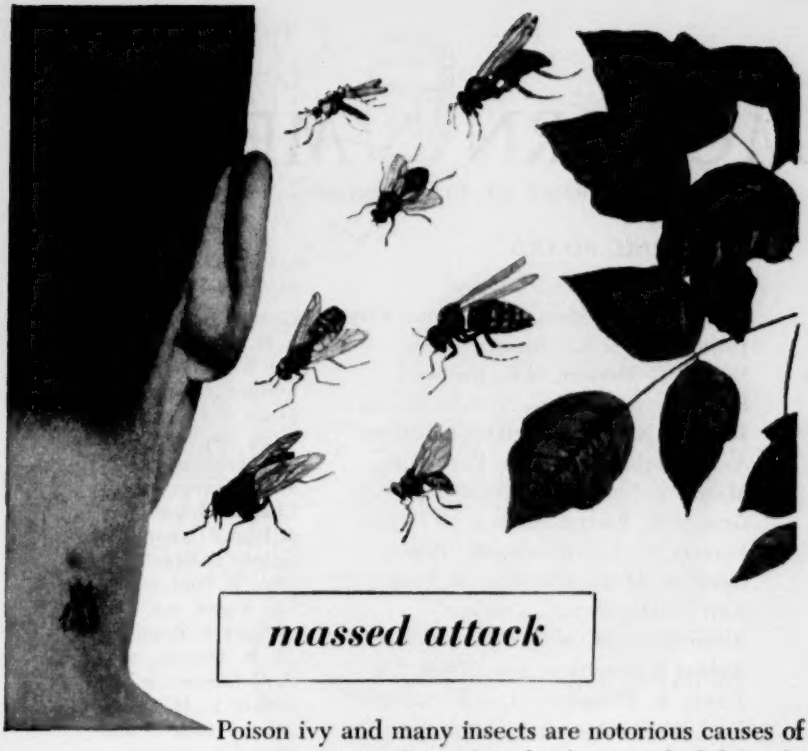

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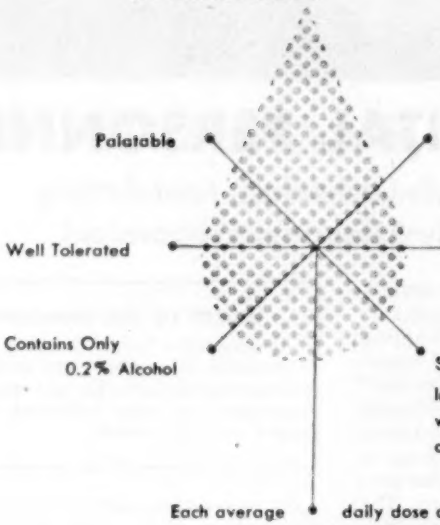

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VOL. 18, NO. 10

THE MAN ON THE COVER is Dr. Edwin B. Plimpton, orthopedist and member of the Editorial Board of *Modern Medicine*. He is on the attending staff at the Hospital of the Good Samaritan, Hollywood, and at Presbyterian and Queen Angels hospitals, Los Angeles. He also serves as consultant to St. Josephs Hospital in Burbank, Calif. In addition to his practice in Los Angeles, he maintains an active interest in medical education and participates in orthopedic clinic work there. The Symposium on Fractures which appears in this issue was planned and supervised by Dr. Plimpton. The Foreword on page 41, explaining the objectives of the Symposium, was written by him.

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LETTER FROM THE EDITOR

Dear Reader:

The other day a hospital administrator complained to us that he just couldn't find the time to read all that he wanted to. The burden of the printed word lies even more heavily on the physician.

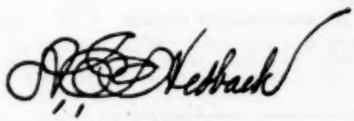
There are thousands of publications of special interest and, each year, thousands of books, all with interesting news and data. But, alas, reading must compete with radio, sports, television, and just plain relaxation for its share of leisure time. And so the unceasing accumulation of facts piles up until even the most comprehensive mind is daunted.

The man of science who contributes to this flow of knowledge finds himself working in ever narrowing fields of inquiry, so intense has specialization become. The medical investigator works under the same pressure of specialization. Nor does the clinician escape. If he specializes, he tends to do so at the expense of his knowledge of medicine as a whole. The deluge of publications makes it difficult for him to know what workers in adjacent fields are doing.

If you had the wealth of Croesus, one way to meet the problem would be to gather a great staff of readers to skim off the essential facts for you. A far simpler solution, however, is to read MODERN MEDICINE regularly. Let us be your staff of readers and do the winnowing for you.

Our entire organization is dedicated to the task of seeking out and reporting to you useful information on diagnosis and treatment. Through the combined efforts of our Editorial and Consultant Boards, MODERN MEDICINE presents a synoptic view of the outstanding medical literature of the world twice each month.

Reading time is valuable time. MODERN MEDICINE coordinates a variety of skills and talents to conserve your reading hours and to make each one more productive.



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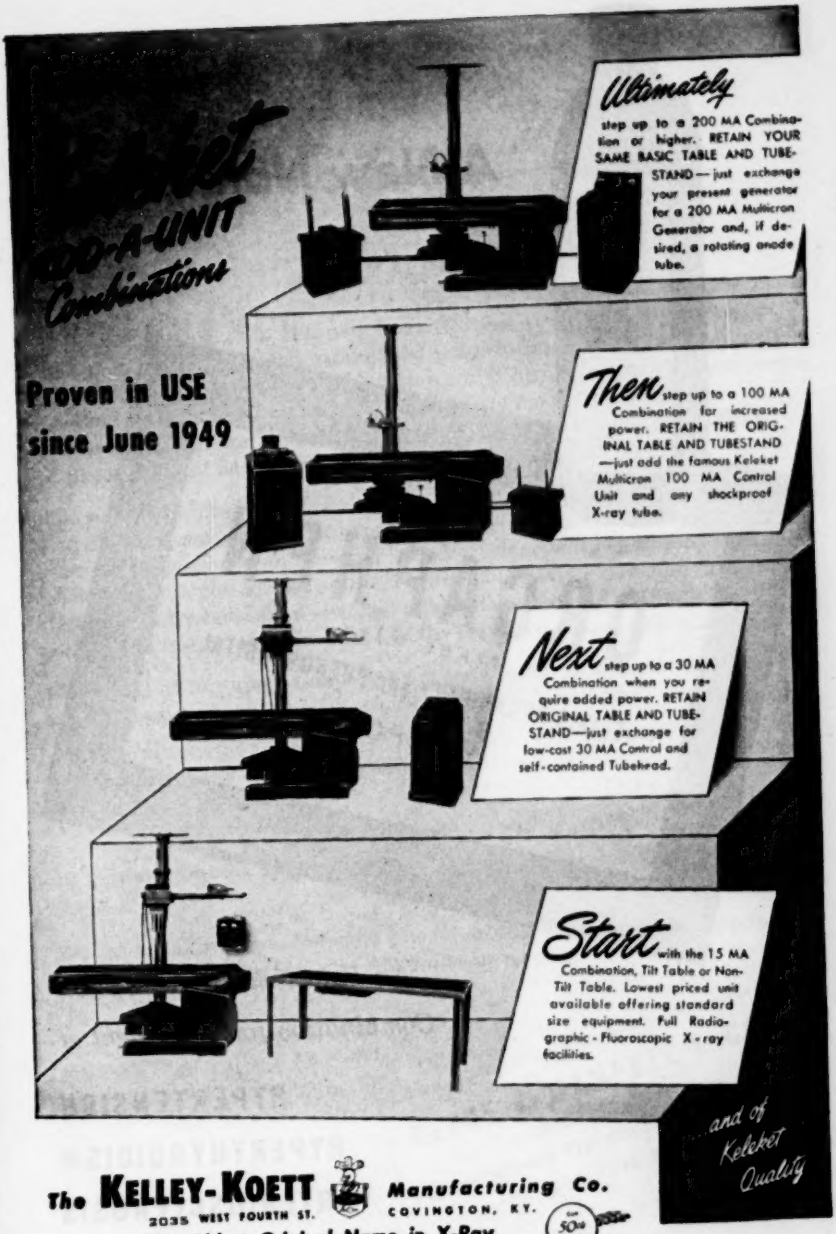
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Correspondence

Communications from the readers of MODERN MEDICINE *are always welcome. Address communications to The Editors of* MODERN MEDICINE, *84 South 10th St., Minneapolis 3, Minn.*

Blood Pressure and Position

TO THE EDITORS: I would like to correct two statements which were made in the abstract of our article on blood pressure and surgical position, which appeared in *Modern Medicine*, Mar. 1, 1950, p. 64.

The authors did not state in the original article that "autotransfusion" succeeds more often than pressor drugs in correcting the hypotension which may follow spinal anesthesia. No such analysis of the data has been made. It is true, however, that when pressor drugs have failed in this regard, lifting the legs has been successful. Secondly, while a type of alteration of the pulse contour does indicate a change in total peripheral resistance, such alteration does not differentiate where pooling of blood has occurred, i.e., viscera or legs.

LYSLE H. PETERSON

Philadelphia

Practical Journal

TO THE EDITORS: May I take this opportunity to thank you for what I consider a well-edited, practical, and convenient medical journal? It is one of the few journals that I read from cover to cover.

E. FREEMAN HERSEY, M.D.

Boston

Caution Urged with Digitoxin

TO THE EDITORS: I wonder if you would print the following note of warning addressed to all physicians who use Digitoxin in the treatment of heart cases. Since Dr. Harry Gold first recommended its routine use instead of digitalis whole leaf preparations, Digitoxin has been widely used.

It cannot be emphasized often enough that Digitoxin is an extremely powerful drug, the most powerful of the digitalis glycosides, and that the margin of safety is narrow.

Moreover, the average maintenance dose advocated by Dr. Gold, 0.2 mg. daily for adults, has proven too large in many cases. I have observed 1 or 2 patients who have been severely overdigitalized by prolonged administration of as little as 0.05 mg. daily.

During the past two years I have seen 6 elderly patients with complete heart block, brought on by prolonged administration of Digitoxin. In each case, the patient's physician had given a prescription for Digitoxin, usually 0.2 mg. daily, and then had not examined the patient for several weeks.

One of the patients, a seventy-six-year-old man who had been taking the named daily dose of Digi-

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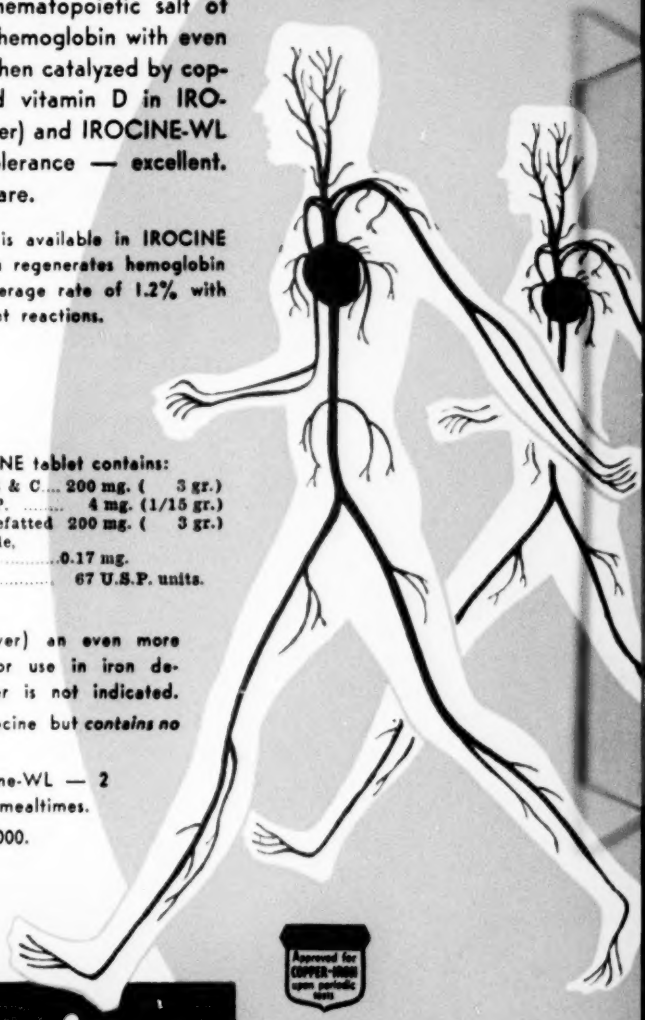

Formula: Each IROCINE tablet contains:

Iron Sodium Malate, R & C	200 mg. (3 gr.)
Copper Sulfate, U.S.P.	4 mg. (1/15 gr.)
Liver, desiccated and defatted	200 mg. (3 gr.)
Thiamine Hydrochloride, U.S.P.	0.17 mg.
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IROCINE-WL (without liver) an even more economical preparation for use in iron deficiency anemia when liver is not indicated.

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Packaging: 100, 500 and 1000.

Reed & Carnrick
JERSEY CITY 6, N.J.

Alracomp

toxin for several weeks, had a ventricular rate of 36 when he came under my care. He died a few days later of multiple mesenteric thromboses brought on, undoubtedly, by the marked slowing of his circulation.

Two other elderly patients with Digitoxin-induced heart block suffered cerebral thromboses from which, fortunately, both recovered.

I have made it a rule to use Digitoxin in the maintenance therapy of cardiac patients only if I can examine the patient at least once a week. When this is impossible, I employ the whole digitalis leaf preparations which have a considerably wider margin of safety, so that overdigitalization is much less likely.

GERHART A. DRUCKER, M.D.
Tacoma

Time for Rejoicing

TO THE EDITORS: May I congratulate you on your excellent Symposium on Physical Medicine and Rehabilitation. Your magazine has always been most informative; however, the articles on physical medicine are exceptional.

Your choice of authors and their most interesting and scientific manner of handling the subject matter make this issue of *Modern Medicine* exactly what the name implies.

Having pioneered in physical medicine for the last twenty-nine years, I am well aware of the heartaches involved.

Naturally, it is for the "early believers" and myself a time for rejoicing that physical medicine and rehabilitation have actually been accepted as the "third phase of medicine."

HARRY J. POWERS, M.D.
Palm Springs, Calif.

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This author suggests Butisol Sodium for the management of the tense, worried, nervous insomniac rather than the patient unable to sleep because of organic disease.

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Tablets, 15 mg. (¼ gr.), lavender
Tablets, 30 mg. (½ gr.), green
Tablets, 50 mg. (¾ gr.), orange
Tablets, 0.1 Gm. (1½ gr.), pink
Capsules, 0.1 Gm. (1½ gr.), lavender

CAUTION: Use only as directed.

1. Dripps, R. D.: Selective Utilization of Barbiturates, J.A.M.A. *139*:148-150 (Jan. 15) 1949.

2. New and Nonofficial Remedies, Council on Pharmacy and Chemistry, A.M.A., J. B. Lippincott, 1949, pp. 456-457.

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Questions & Answers

All questions received will be answered by letter directed to the petitioner; questions chosen for publication will appear with the physician's name deleted. Address all inquiries to the Editorial Department, MODERN MEDICINE, *84 South Tenth Street, Minneapolis 3, Minnesota.*

QUESTION: I have a couple as patients who have been using surgical jelly as a lubricant for coitus. Could the sterility of their marriage be due to this practice? Two jellies have been used, K-Y and Lubafax. Are these effective contraceptives?

M.D., New York

ANSWER: *By Consultant in Gynecology.* Surgical jellies should not be considered responsible for sterility if used for lubrication in small quantities. Both the products named have little, if any, spermicidal capacity and are not effective contraceptives.

QUESTION: Can you suggest a program of treatment for a woman, fifty-five years old, who has urinary incontinence dating from childhood?

M.D., Wisconsin

ANSWER: *By Consultants in Urology and Gynecology.* The first step would be to determine whether the condition is true incontinence, that is, whether the bladder is empty all the time. Then one should ascertain by catheterization at the end of urination whether the condition is overflow incontinence and how much urine is left in the bladder.

In a patient who has been incontinent since childhood, one should suspect the presence of an ectopic ureteral orifice in the distal portion of the urethra opening on the introitus or on the anterior vaginal wall. Characteristically, such a patient voids normally, has no residual urine, but is always wet with urine. Careful urographic and cystographic examinations are required.

Nonoperative treatment of urinary incontinence includes exercises which consist of alternately starting and stopping the stream during urination.

Sympathomimetic drugs such as ephedrine sulfate, 25 mg. three times daily, have been employed. With urethral or bladder neck infection, urethral dilation and local application of silver nitrate may be useful.

For the case cited, which is probably due to some type of congenital neurologic dysfunction, it is doubtful if these measures would be of help.

QUESTION: What is the status of chemotherapy for malignancy?

M.D., South Dakota

ANSWER: *By Consultant in Internal Medicine.* If by definition chemotherapy includes only chemical substances, the agents used in treatment of malignant conditions are arsenic, benzol, urethane, and nitrogen mustards. Arsenic and benzol have long been used for leukemia. Urethane has recently been recommended for

(Continued on page 28)

pruritus

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*Shelmire, B, *Postgrad. Med.*, 4:443, 1948.

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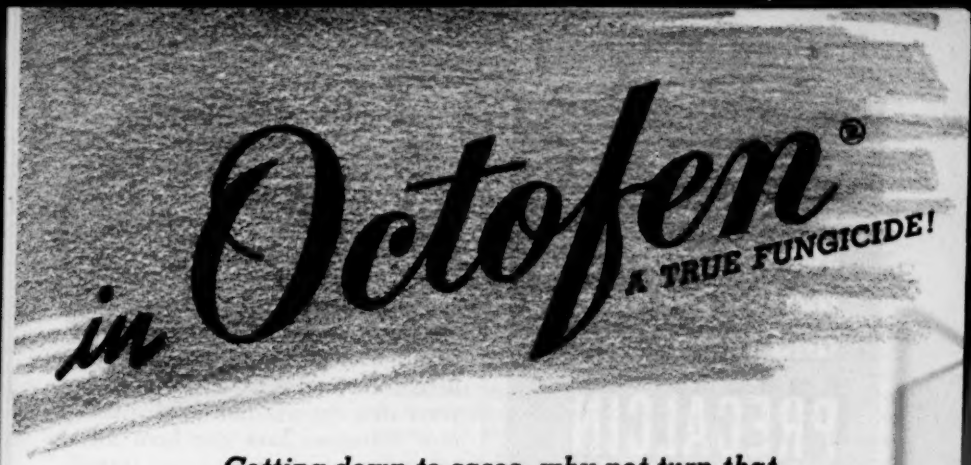

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chronic myelocytic leukemia, and nitrogen mustard for Hodgkin's disease and related lymphogenous diseases. If the term chemotherapy is broadened to include hormones, other agents should be mentioned. Androgens, usually as testosterone propionate, have been advocated to control metastases of breast cancer in women near the menopause; estrogens have been used for the same purpose ten years after the cessation of menstruation. Estrogens have also been used in men to check growth and spread of cancer of the prostate gland. If chemotherapy extends to metabolic controls, experiments with folic acid antagonists such as pteroylglutamine acid, PGA, may be included. Attempts have been made to check excessive growth of leukemia cells with PGA. Cancers of organs, except those of the mammary and prostate glands, as noted, have not been susceptible to chemical, hormonal, or enzymatic substances. For blood dyscrasias, x-ray therapy is safer, more easily controlled, and generally more satisfactory than chemotherapy.

QUESTION: A patient of mine when looking at car lights or at a burning match at night sees the light bulb or flame plainly, surrounded by a circular blue field, edged with red. The appearance is the same with or without his glasses. What do you say is the cause?

M.D., Arkansas

ANSWER: *By Consultant in Ophthalmology.* This patient almost certainly has one of three conditions: lens opacity, corneal dystrophy, or glaucoma. The symptoms described have to be accounted for on the basis of one of these three diseases. The diagnosis could be readily made by slit-lamp examination and measurement of intraocular tension.

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Diagnostix

Here are diagnostic challenges presented as they confront the consultant from the first clue to the pathologic report. Diagnosis from the Clue requires unusual acumen and luck; from Part II, perspicacity; from Part III, discernment.

Case MM-167

THE CLUE

ATTENDING M.D: We have a very perplexing problem in the ward. This is the case of a thirty-year-old woman whose illness apparently began six months ago with a cough, followed, two months later, by expectoration of blood-tinged sputum. The chest roentgenogram at that time was interpreted as negative. Eight months after the onset of the cough, she had a chest cold with hemoptysis. From then on she has had recurrent attacks of chest trouble and hemoptysis with increasing dyspnea. She received sulfathiazole for the chest cold. Soon thereafter she had nosebleeds and, within a month, a migrating polyarthritis, which was treated by sulfadiazine. In the past two months she has had repeated hemoptysis, epistaxis, increasing dyspnea, profuse perspiration, and a fever as high as 104°.

VISITING M.D: Has she lost weight?

ATTENDING M.D: Some 30 lb. in the last two months.

VISITING M.D: Does she have chills, and what do the chest roentgenograms show now?

ATTENDING M.D: She has severe chills with the high fever; the chest film is read as "miliary tuberculosis."

VISITING M.D: Does the sputum show organisms; and what is the Mantoux test?

ATTENDING M.D: Sputum has no significant bacteria, and the Mantoux reaction is negative.

PART II

VISITING M.D: This is a fascinating case; may I see the patient?

ATTENDING M.D: Certainly, just down the corridor *(They walk into the ward).*

VISITING M.D: *(Examines the patient)* I notice a diffuse erythematous macular rash over the entire body, particularly on the back. The patient is very pale and certainly looks acutely ill. Has she had other symptoms or any childhood illness that is relevant?

ATTENDING M.D: She has had slight headaches and back pains for two months. She did have asthma as a child and, until three years ago, repeated, severe attacks.

VISITING M.D: Blood pressure is normal; pulse is 120; there is a small amount of blood on the tongue. A few small cervical lymph nodes

(Continued on page 35)

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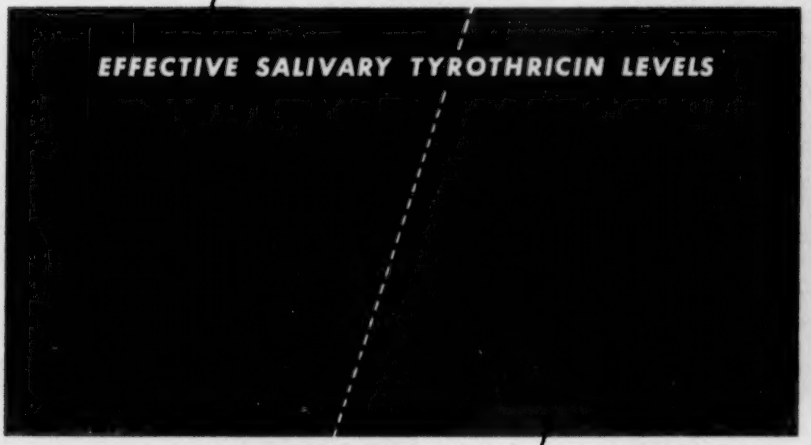

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FORMULA: Each specially constructed tablet contains Pancreatin, U.S.P., 300 mg.; Pepsin, N.F., 250 mg.; Bile Salts, 150 mg.

DOSAGE: One or two tablets after each meal, or as directed by physician, without crushing or chewing.

AVAILABLE: Bottles of 25 and 100.

REFERENCES:

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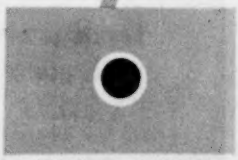

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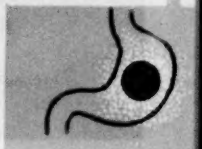

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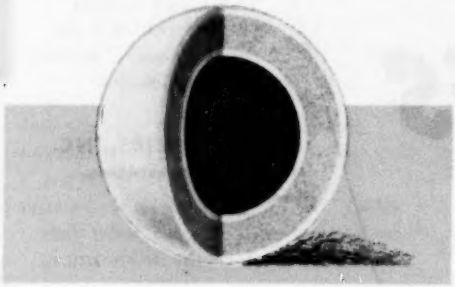

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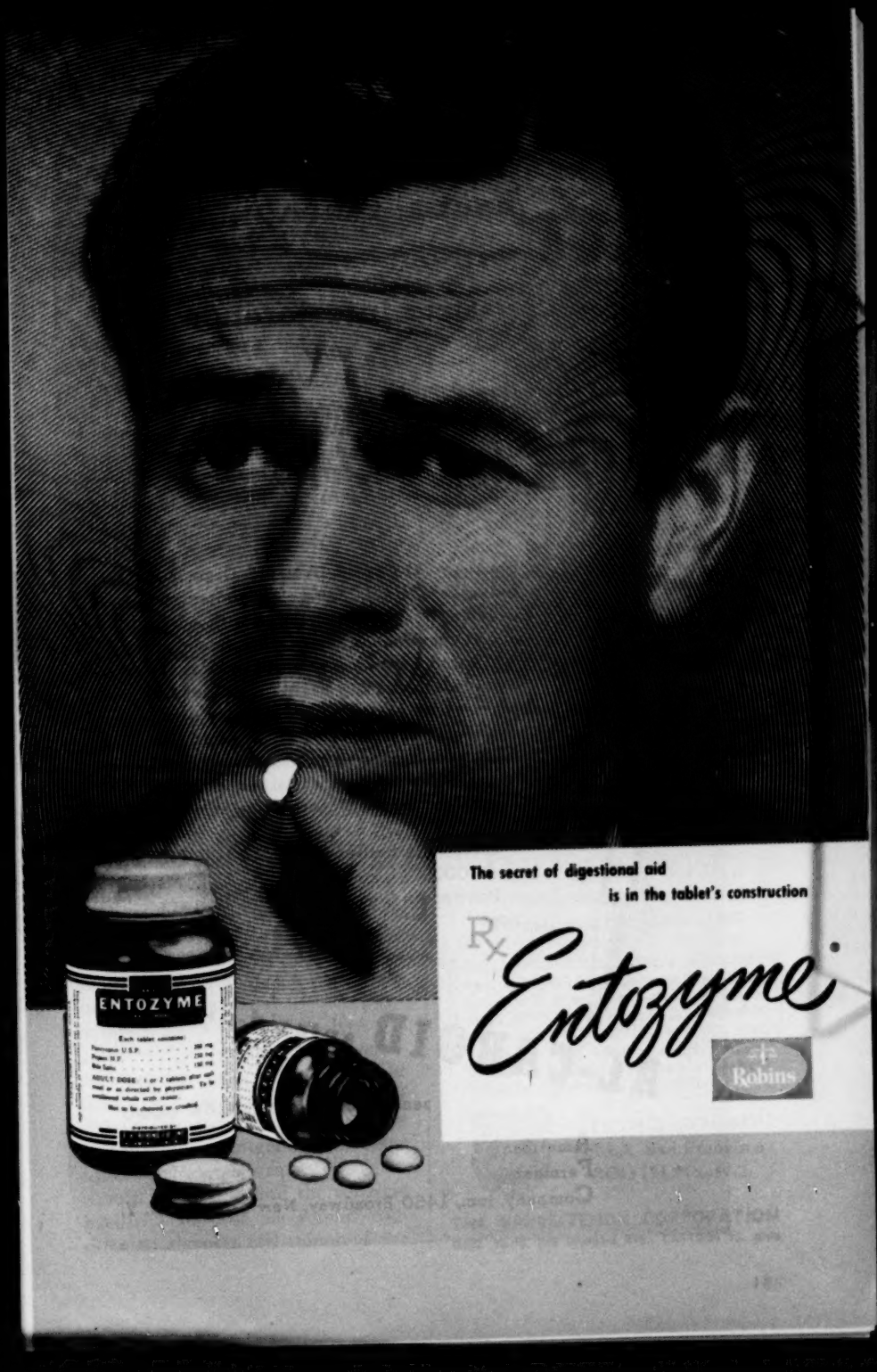
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are palpable. I note wheezes and loud moist râles over both lungs, dullness of the upper half of both, harsh breath sounds over the left subclavicular area. The rest of the physical and neurologic examination is negative. Let's look at the laboratory record.

PART III

ATTENDING M.D: The urinalysis shows normal specific gravity, 3 plus albumin, and innumerable red cells. Blood urea nitrogen is 150, protein nitrogen 200.

VISITING M.D: Well, at least we're sure she has uremia. The albumin probably accounts for the high specific gravity. Certainly with this degree of renal shutdown, she could not concentrate urine. Continue, please.

ATTENDING M.D: There are 4 million red cells, leukocyte count is 30,000, sedimentation rate is 65 mm. in one hour. Cultures of the blood and spinal fluid and of the sputum so far are sterile. Gastric contents do not contain tubercle bacilli.

VISITING M.D: I do not believe the patient has tuberculosis or, if she has, there is something else. Whatever disease she has is widespread. . . . Let me think. She is young, acutely ill, with rapid exacerbation of an eighteen-month illness, pulmonary lesions, renal lesions, polyarthritis in the past, rash, leukocytosis—normal blood pressure—some adenopathy. Of course she could have had hematogenous spread of miliary tuberculosis and, looking at the chest roentgenogram, I see some cavities. I suspect that we should be able to find the tubercle bacilli. I suppose we should consider an alveolar cell tumor of the

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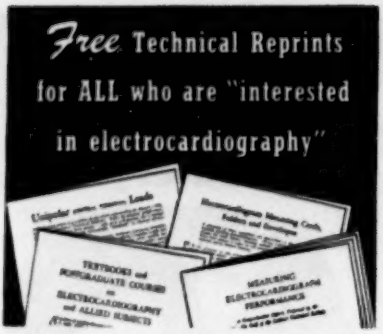

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lung, but the nodules are very small. All I can say is she has nephritis and pulmonary disease following an illness treated with sulfathiazole and sulfadiazine. I suspect. . . .

PART IV

VISITING M.D: I suspect the patient probably had a diffuse collagen disease, perhaps periarteritis nodosa. *(Period of one week passes, during which time the patient has spiking fever, progressive culminating course with projectile vomiting, nosebleeds, anemia, anuria, terminal hypertension. She expires and an autopsy is performed.)*

PATHOLOGIST: There is anasarca, intraperitoneal fluid and bilateral pleural effusion, extreme pulmonary consolidation, chronic pneumonitis, and fibrosis. The heart is normal. Extensive glomerular nephritis, subacute type, is found, with necrotic acute vascular lesions in the adrenal, kidney, and bowel. The case demonstrates the potential danger of sulfonamides, plasma, serum, and other agents in the causation of periarteritis nodosa. I wonder what large intravenous doses of antihistamine drugs would have done?

"Were you planning to do a lot of sitting today?"

[redacted]

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1. Wilbur, D. L.: J.A.M.A. 141:1199 (Dec. 24) 1949

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Symposium on Fractures

Foreword

EDWIN B. PLIMPTON, M.D.
Los Angeles

THIS issue of MODERN MEDICINE is given over to a symposium on fractures, which, it is hoped, will be of particular aid to those physicians who care for a great many patients with such injuries but do not necessarily limit their work to the field. The continuing expansion of industry, the mechanization of agriculture, and the tremendous hazards associated with forty million automobiles on our highways have greatly increased the incidence of fractures and associated injuries.

The majority of fractures are treated by general practitioners, frequently not in well-equipped hospitals, but in the home or in the office. Adequate early care greatly influences the end result, and the intelligent application of general principles to the individual problem is more important than complicated procedures and elaborate equipment. The basic principles of emergency care, debridement, splinting, traction, fixation in the position of optimum function, early motion, and roentgen control are matters of common routine.

Wonderful advances in the treatment of fractures have been made in the past score of years especially with the experience gained in the recent war. However, many of the basic principles of treatment remain unchanged.

The goal in fracture treatment is complete functional restoration in the shortest possible time. In striving for this, careful follow-up treatment is as important as the reduction. Very often, injury to the soft tissue is more serious than the fracture itself and treatment should be based on the under-

standing of injuries involving a complicated human mechanism.

Roentgenology, so perfected and universally available as to limit the requirements of the physical examination of injury, offers concrete evidence of the progress of healing, as well as emphasizing the necessity for striving to obtain close anatomic restoration of injured structures. The development of chemotherapy and the great advances in antibiotics have been a major milestone in the therapy of fractures, in both the prevention and the treatment of infection. The great decrease in occurrence of osteomyelitis in recent years has been largely traceable to the use of these agents.

The development of special metals incorporated into a variety of plates, pins, nails, bolts, rods, and screws has greatly advanced the field of internal fixation of fractures. To a very considerable extent the use of such elements is part of the specialist's armamentarium.

The general practitioner finds that the reduction of many fractures is relatively simple, yet a severe or complicated injury in the same area may tax the ingenuity and skill of the orthopedic surgeon. If the problem presents difficulties beyond the ability of the physician, he should safeguard himself and his patient by promptly seeking the opinion and aid of a specialist. The patient considers his injury in the light of a full return to function without deformity and, unless he recovers completely, is often greatly dissatisfied. The frequency of malpractice suits in fracture cases has become a major problem and is a constant threat and source of apprehension to physicians. An understanding and proper judgment of each problem, with the application of commonsense principles, will prevent most of the unfortunate results.

Principles in Treatment of Fractures

REX L. DIVELEY, M.D.*
University of Kansas, Kansas City

Prepared for Modern Medicine

THE widespread mechanization in the past three decades has changed in innumerable ways the conditions under which we live. Among the changes has been an increased danger of suffering injury, not only as an occupational risk but also in routine daily living.

The annual accident toll in the United States is well up in the millions, and the permanently disabled each year number several hundred thousands. Fractures rank high in the injuries which our civilian population suffers each year, comprising 17.7% of all industrial injuries. Between 500,000 and 1,000,000 fractures probably occur annually.

Because of the severe trauma that machinery inflicts and the violent impact associated with automobile collisions, fractures today are far more extensive and serious and are complicated by damage to soft parts much more frequently than in the past. Thus, the serious fractures met with today frequently lead to some degree of permanent disability.

No problem in the practice of the general practitioner or surgeon gives him more difficulty than fractures, not only because of the number and increasingly serious nature of the injuries, but because patients today are more exacting. They will not accept a malposition or poor alignment but demand as nearly perfect a result as can be obtained. The standard of this result is generally that which can be obtained by the fracture specialist.

World War II, as did World War I, aroused widespread interest in fracture management, particularly of compound fractures, because such injuries ranked high in the casualty lists. This interest must not be allowed to wane and the extensive experience in fracture treatment acquired by the medical department of our Armed Services be wasted.

To treat fractures successfully one must adhere to certain basic principles involved in the management of even the most simple solution in the continuity of a bone. Lack of appreciation or indifference to the following cardinal principles will lead to failure:

1] Fractures should be splinted at the place of accident. The patient should then be moved to the office or hospital for permanent dressing or definitive treatment.

2] First-aid treatment of a compound fracture should be confined to protecting the open wound by a clean and, preferably, sterile dress-

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ing, and to controlling serious hemorrhage by pressure directly applied by the protecting dressing. Only when hemorrhage is excessive and uncontrollable by pressure should a tourniquet be used.

3] Careful physical and roentgen examination and evaluation of the problem should be made before treatment is attempted. Notes should be made of any injury to blood vessels, nerves, and soft parts.

4] Every fracture should be looked upon as a surgical emergency and given definitive treatment as soon as possible after the patient reaches the hospital. Whatever form of fixation is used, frequent observation should be made to guard against pressure sores and tight bandaging. The immobilization should extend one joint above and one joint distal to the fracture and must be adequate from the time of reduction until healing is complete.

5] Roentgenograms in at least two planes should be made before and after reduction and repeated at intervals to be sure that the position of the fragments is being maintained.

6] The after treatment of fractures is as important as the reduction. Light massage should be started early, followed by gentle passive and active exercises. The patient should be under close supervision until rehabilitation is complete.

Having enumerated these six basic principles of fracture treatment, may we review them with emphasis:

1 A sound principle in first-aid treatment when an important bone, the skull, or the spine is fractured is to avoid moving or disturbing the patient until he is properly splinted for transportation. Observance of this precaution reduces shock and suffering, cuts down muscle spasm, thereby preventing increased distortion of fragments and interposition of soft parts, and, in short, makes reduction much less difficult.

The patient should be made as comfortable as possible and be protected from additional injury until proper splinting is obtained and transportation procured. Well-meant, meddlesome efforts to do something cause far more damage than is realized by adding trauma of unnecessary movement at the fracture site.

Fractures in bones of the upper extremities may be splinted on a straight board or in a sling. Major fractures, such as in the pelvis, hip, femur, or leg bones, should be splinted on a long board or in a traction ring splint. A pillow splint may be used in leg or ankle fractures. A patient with a head injury or possible spinal fracture should be transported lying on a firm support or on a blanket lift.

2 Every compound fracture is a contaminated wound. Whether this becomes an infected wound depends upon the lapse of time between the injury and the application of definitive therapy and upon the thoroughness of emergency treatment. After a lapse of six to eight hours, a compound fracture must be considered infected.

The time element, then, is of paramount importance. No attempt should be made to clean the wound in the field or on the roadside, but

the wound should be dressed with a clean or sterile dressing to prevent further contamination.

3 As soon as the patient reaches the hospital or the place where definitive treatment is to be carried out, a careful and thorough physical and roentgen examination should be made. This examination is to be accomplished with a minimum of disturbance to the area of the involved part. Particular attention should be given to any damage to the surrounding soft parts, the blood vessels, and the adjacent nerves, as such complicating injuries are always of great importance. Roentgenograms should be made in at least two planes; then, and only then, can the operator plan definitive treatment. No manual examination can give the information that a properly made roentgenogram affords.

4 A fracture is considered a surgical emergency and immediate reduction is instituted for several obvious reasons. The first reason is that reduction is accomplished with much less difficulty if the hemorrhage and traumatic exudate have not infiltrated adjacent soft tissues and produced a boggy induration.

A second reason is that within a few hours after a fracture, the hemorrhage begins to organize into granulation tissue. Manipulation carried out after organization has started will tear and injure the granulation tissue which is already forming a bridge between the bone ends and will delay fracture healing.

Reduction of the fracture is, of course, the first step in the fracture treatment and should be carried out immediately.

Anesthesia, local or general, is used because no reduction can be successfully completed, except gradual reduction through traction, without relaxation of the muscles.

When gradual traction is to be used, the limb should be placed in balanced traction, with either skin or skeletal attachment, and with adequate and efficient countertraction. When gradual and continued traction is employed, the apparatus must be checked often, not less than once daily.

The question of adequate immobilization following reduction is of paramount importance. Every physician today subscribes to the principle of immobilization of fractures.

Unfortunately, this principle is too often given lip service only, for there is a vast difference between immobilization and adequate immobilization. The difference is not always appreciated.

Aside from interference with the blood supply of fractured bones, poor immobilization in all probability is the most frequent cause for delayed union or nonunion. The reason for this is that improper immobilization permits twisting and shearing movements at the fracture site which, if allowed to continue, will tear the delicate granulation tissue joining the fractured bone ends. Thus continued hyperemia at the fracture site, decalcification, and delayed union are produced. The important point to be borne in mind when immobilizing a fracture is that the joints proximal and distal to

the fracture site must be controlled or immobilized.

Circular plaster casts and molded plaster splints provide the best forms of immobilization. Wood and metal splints are less likely to do so. Properly applied and maintained traction gives adequate immobilization, but must be carefully and frequently supervised.

Immobilization must be maintained until the fracture is healed and roentgenograms show sufficient callus to maintain the alignment of the fragments when the splinting is removed.

5 Roentgenograms should be taken immediately after reduction and at frequent intervals during the immobilization period. All too often the fragments slip and are displaced; only frequent roentgen examination will detect this complication.

6 Rehabilitation of a patient who has sustained a fracture is most important. To rehabilitate means to restore to former capacity. As applied to an individual who has sustained a fracture or fractures, rehabilitation implies restoring not only the affected limb to normal, or as near so as possible, but the patient's entire body, both mentally and physically.

Too often the patient who has had a cast or splint removed is left to find his way back as best he can to health and vigor. Convalescence must be planned from the time treatment begins until the patient is returned to his former duty. Only by a planned recovery period are the best results achieved.

Light massage of the adjacent areas should be instituted early, followed by gentle passive and active exercises to adjacent joints. When all immobilization is removed, passive and active exercises should be started. Recovery of a limb's function depends largely on the restoration of the muscles to their former state. Muscle power and development can only be achieved by active exercises on the part of the patient.

The patient should be under close supervision during the entire period of convalescence and rehabilitation and should only be discharged when the affected part is returned to as near normal function as possible. Our obligation as physician does not end until the patient has returned as nearly as possible to his former state.

CHRONIC NONSPECIFIC TENOSYNOVITIS with effusion is a rare condition, particularly at the ankle. The symptoms may be present but unrecognized for a long period of time. Paul W. Lapidus, M.D., and Harold Seidenstein, M.D., of Hospital for Joint Diseases, New York City, describe 3 such cases. The posterior tibial sheath was involved in 2 cases, and the flexor hallucis longus in the other. The symptoms disappeared with removal of the synovial tendon sheath.

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Fractures of the Shoulder Girdle

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Prepared for Modern Medicine

EXCEPT in isolated instances, completely normal function of the arm is dependent upon the integrity of both the scapula and the clavicle. In this respect, fractures of either bone present problems of clinical interest.

Fractures of the clavicle or scapula may be simple or compound, but the latter constitute a relatively inconsequential percentage. When compounding does occur, the fracture is often associated with other injuries of so serious a nature that it assumes a role of secondary importance. In any event, the existing wound and any infection should be submitted to the accepted methods of treatment by debridement, antibiotics, and transfusion, if necessary. Immediate hospitalization is undoubtedly warranted.

FRACTURES OF SCAPULA

Fractures of the scapula, formerly considered relatively rare, have been found by roentgen examination to be not uncommon. These fractures may be caused by muscular pull, indirect violence, or, more often, direct injury. The fracture may involve any part of the bone, including the acromion, body, glenoid cavity, scapular neck, spinous process, inferior angle, superior angle, coracoid process, vertebral border, and axillary border.

Of these, the first three are the most frequently seen and are usually the result of direct injury. The last five are encountered very rarely and may be caused by muscular violence or direct injury.

Diagnosis of the various fracture forms may be made presumptively on the basis of clinical examination. The classical signs of fracture—impairment of function, with local tenderness, crepitus, and deformity—may be easily elicited, because of the superficial location of the spinous process, vertebral border, axillary border, and acromion process.

In fracture of the scapular neck, the deformity, with prominence of the acromion process, may be deceptively similar to that seen in dislocation of the shoulder. Presence of the humeral head in the glenoid fossa and a negative Dugas' sign are, however, sufficiently significant to permit differentiation between the two conditions.

The x-ray must be considered the court of first as well as last resort. By its aid the existence of many previously unsuspected fractures has been definitely demonstrated. Espe-

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cially in children, the x-ray permits easy differentiation between fractures, epiphyseal separations, and delay or irregularity in development of the seven different centers of scapular ossification. These diagnostic errors may be of little importance from the point of view of therapy, but they loom large in cases with medicolegal aspect.

Generally speaking, the therapy of scapular fractures is limited. Protected as the scapula is by powerful

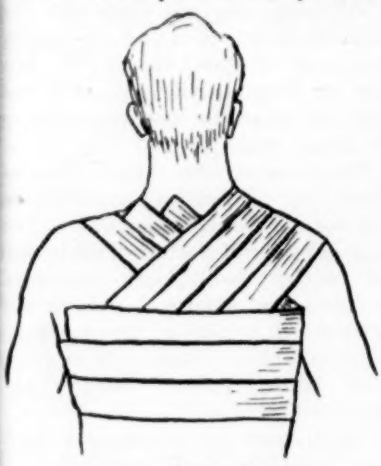

Figure 1. Scapula dressing

muscle layers, dislocation of the fractured fragments is not of any great significance. Simple immobilization by a pressure bandage and adhesive dressings, permitting slight motion at the glenohumeral joint, for a period of four to five weeks most commonly suffices to bring about functional restoration in fractures of the *spinous process*, the *inferior or superior angles* of the body, and the *axillary or vertebral borders* (Fig. 1).

Occasionally, a fractured vertebral border overlaps the body of the scapula. In such instances, traction on the abducted arm will exert sufficient tension on the rhomboid muscles, attached to the vertebral border, to permit satisfactory correction.

Isolated fracture of the *coracoid process* from pull of the attached muscles is extremely rare. Whether this fracture occurs at the tip or base of the process, operative repair is not justified. Since the small fragment cannot otherwise be controlled, therapy is limited to preventing excessive displacement by relaxing the pull of the attached muscles, the pectoralis minor, coracobrachialis, and biceps. The arm is fixed across the chest in adduction, slight flexion, and internal rotation, with the hand on the opposite shoulder.

Fractures of the *acromion process* may occur either at the base or lateral to the acromioclavicular joint. The latter type requires nothing more than fixation by adhesive strapping.

The former, if associated with dropping of the shoulder, must be reduced to avoid limitation of abduction at the shoulder. Since the fractured fragment is displaced downward and inward under the combined action of the deltoid and the weight of the arm, realignment can be accomplished only by upward pressure through the humeral head.

Most commentators advise application of force to the flexed elbow with counterpressure over the outer end of the clavicle, as in the treatment of acromioclavicular dislocations. It seems mechanically more accurate to produce counterpressure through use of a thick pad of felt applied over the outer end of the spi-

nous process, so that the fractured acromion may be replaced upward against the fixed scapula from which it was broken.

Isolated fracture of the *scapular neck* is relatively rare. If the fractured fragment is impacted into the axillary border of the scapula so that the plane of the glenoid is directed downward, little change in the position of the fragment can be expected from any closed method of treatment. Slight if any disability results and no radical measures are justified.

In some instances, the acromion process is unduly prominent and gives the appearance of a shoulder dislocation. In such cases, and when the results of ambulatory treatment are unsatisfactory, adequate reduction of the fragment may be obtained by balanced traction, with the patient supine and the arm abducted to a right angle.

Fractures of the scapular neck are frequently associated with fractures of the *glenoidal cavity*. Because of the danger of stiffness in the shoulder joint, these fractures are probably best treated by traction through the abducted humerus, with the patient supine.

Fractures of the *glenoidal rim* are not uncommonly seen with dislocations of the shoulder, particularly of the chronic or recurrent type. In recent treatment of the latter condition rim fractures have acquired importance and surgical reattachment of the small fragment by means of wire staple has been undertaken.

FRACTURES OF CLAVICLE

In contradistinction to the scapula, the clavicle is one of the most frequently fractured bones in the body. Statistically it comprises 5 to 10% of all fractures. More than one-third of all clavicle fractures are said to occur in children under the age of five. In children, fracture of the clavicle is produced by the same mechanism which in adults leads to dislocation of the shoulder. The clavicle, the sole osseous connection between the scapulohumeral structures and the trunk, must bear the brunt of all forces which tend to push the humeral head inward against the chest.

The clavicle is a doubly curved bone. The inner portion is convex forward and the outer portion convex backward. The inner end, which articulates with the sternum, is further bound to the first rib by the rhomboid ligament. Its outer end, which articulates with the acromion process, is firmly stabilized against the coracoid process of the scapula by the stout binding of the conoid and trapezoid ligaments. Corresponding to this anatomic arrangement, fractures of the clavicle have been classified as occurring at the inner or outer end or in the middle portion of the shaft.

Fracture of the *inner end* of the clavicle is relatively rare and is the least common of clavicular fractures, probably because of the greater mobility of this end of the bone as compared with the outer end. Provided the rhomboid ligament remains intact, displacement is usually minimal. The outer fragment, under the influence of the sternomastoid and pectoral muscles, may be displaced inward or inward and upward.

When the rhomboid ligament is ruptured, the inner fragment may

also be angulated upward by the pull of the sternomastoid acting through the outer fragment. In the latter event, treatment by closed method is not very satisfactory because of the inability to control the inner fragment or to counteract the force of the sternomastoid muscle.

In most instances, even open reduction is not entirely satisfactory, and often an unsightly angulation is residual.

In fracture of the *outer end* of the clavicle displacement is also of slight degree because of the firm anchorage afforded by the conoid and trapezoid ligaments. If these ligaments are torn, however, the outer fragment fixed to the acromion process is pulled downward and inward by the weight of the shoulder and the action of the pectoral muscles. Treatment consists in upward displacement of the humerus against the inner clavicular fragment by any of the sling methods used for acromioclavicular dislocations.

The *midportion* is the most common site of fracture of the clavicle and usually occurs where the anterior convexity of the inner two-thirds of the bone goes into the posterior convexity of the outer one-third. In children, the fracture may be greenstick type or complete. In adults, the fracture is usually complete and results in a downward and inner displacement of the outer fragment with an upward displacement of the inner fragment.

Though complications such as injury to the subclavian vessels or the brachial plexus have been described, they are very unusual because of the protection afforded by the subclavius muscle. Nonunion is rare, and adequate alignment and healing usually may be achieved by closed methods. When loss of substance has been extensive, bone grafting and plating may be necessary.

The principle of closed treatment, by upward and backward replacement of the outer fragment, has been practiced since the time of Hippocrates. Though over two hundred different methods of accomplishing the reduction and of holding the fragments have been described, none has yet proven to be universally satisfactory.

The simplest of these procedures is by means of a figure-of-eight bandage crossing in back (Fig. 2). This may be of ordinary bandage and may be reinforced by several turns of plaster over the muslin or by anterior yoke of plaster. In using this form of dressing, especial attention must be given to preventing pressure against the large vessels and nerve trunks which pass beneath the clavicle to the axilla.

Doubtless to avoid these dangers, Sayre's dressing, Velpeau's bandage, and other methods of fixing the shoulder in its upward and backward position were devised. These, however, have the disadvantage of immobilizing the arm and, particularly, the hand and fingers. This immobilization is especially dangerous in persons over forty and may result in a degree of disability compared to which the complete neglect of the fracture deformity would be the lesser of two evils.

For this reason, the various forms of clavicular cross, a great number of which are available from surgi-

cal apparatus manufacturers, are extremely valuable. A thoroughly satisfactory form may be readily constructed by binding two appropriately measured barrel staves together. This cross permits immediate use of the upper extremity and prevents development of disabling stiffness of the hand and fingers.

When accurate reduction and minimal callus formation are desired, its application, however, careful training in orthopedic technic and the facilities of a thoroughly equipped hospital are necessary.

Generally speaking, fractures of the clavicle should be treated by the simplest and not necessarily the most elegant technic. Though a perfect anatomic reduction is esthetically to be desired, a good functional result can be expected even in the

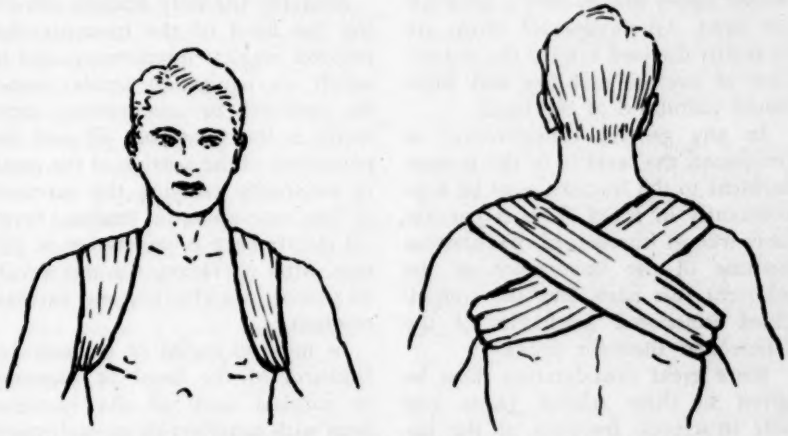

Figure 2. Figure-of-eight bandage may be reinforced by plaster of paris bandage or yoke placed anteriorly between the shoulders.

treatment in recumbency with a sandbag between the shoulder blades is necessary. Within three to four weeks sufficient callus has formed so that ambulant treatment by any of the methods mentioned may be instituted until the callus becomes completely firm.

Within recent years, and in accord with the tendency toward skeletal fixation, a method of intramedullary pinning of clavicular fractures has been devised. When successful, the method is eminently satisfactory. For presence of deformity. Apart from any consideration of an esthetic nature, the primary objective is the restoration of continuity of the clavicular cantilever.

If possible, normal length should be reestablished to maintain the efficiency of the shoulder mechanism. However, since mobility is of the essence in the function of the shoulder, motion in all three components of this compound joint must be preserved even at the risk of anatomic deformity.

Fractures of the Humerus

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Prepared for Modern Medicine

In all fractures of the humerus, it is imperative to remember that the upper arm is only a lever for the hand. All therapeutic efforts are in reality directed toward the restoration of normal mobility and functional usefulness of the hand.

In any general consideration of treatment, the severity of the trauma incident to the fracture must be kept constantly in mind. This is particularly true in fractures of the humerus because of the importance of the adjacent soft parts and the complicated functional mechanics of the elbow and shoulder joints.

Since great consideration must be given to these related joints and soft structures, fractures of the humerus may be considered in three categories for purposes of treatment: as fractures involving either the shoulder, the shaft of the humerus, or the elbow.

SHOULDER JOINT

Fractures of the head of the humerus may be quite severe as to comminution and even as to displacement and loss of alignment and yet good functional results be attained. A rather extensive study a number of years ago, comparing cases of fractures in this area, showed that the end results obtained with no treatment or only a sling were at least equal to those obtained by varied methods of treatment.

Probably the only fracture involving the head of the humerus that requires surgical interference, and in which an equivalent result cannot be obtained by conservative treatment, is the fracturing off and displacement of the portion of the greater tuberosity carrying the insertion of the supraspinatus tendon. Surgical interference is imperative in this case. After operation, the arm should be placed in abduction and external rotation.

In most impacted or comminuted fractures of the head or anatomic or surgical neck of the humerus, even with considerable gross displacement and loss of alignment of the fragments, the results to be obtained by conservative treatment in an abduction splint, with or without traction as indicated, are at least equal, and perhaps superior, to those obtained by open reduction. Moreover, operative hazard is not incurred.

This operative risk should be emphasized when referring to fracture dislocations of the head of the humerus because the incidence of aseptic or septic necrosis in such cases is extremely high when open reduction procedures are carried out within the first few days. The reason is not completely clear, but the occur-

rence is sufficiently frequent to make the experienced surgeon extremely cautious about open reduction in these fractures.

If open reduction is absolutely necessary to obtain apposition, the operation should be delayed at least eight to fourteen days after the injury and the arm should be kept in traction and abduction during the interval.

A recent article has advised open reduction and internal fixation with a modified blade plate, similar to that used on the femur. A more conservative attitude seems advisable, with restriction of this procedure to the rare case in which position cannot be maintained otherwise. Internal fixation is sometimes necessary for patients with multiple incidental injuries but should not be routine treatment for such fractures.

The secret of good end results in all fractures involving the upper humerus seems to lie in early restoration of active motion. This can almost always be instituted in three weeks and, in many cases, the pendulum type of combined passive and active motions can be started even earlier.

The only consideration of equal importance is that the fracture be treated in abduction. This is as readily accomplished in an abduction splint as in a cast.

Neither of these contrivances has anything to be said in its favor as far as comfort is concerned. Preference, if any, probably lies with the abduction splint, which is more readily applied, more adaptable, and much more easily adjusted than the cast and is therefore the lesser of two evils. Either a cast or a splint is better than lying in bed for three weeks and, in most cases, these ambulatory methods are much more feasible from an economic standpoint.

SHAFT OF THE HUMERUS

The seriousness of fractures of the shaft of the humerus usually depends on the degree of radial nerve injury. If present, radial nerve injury is probably of primary importance and exploratory neurolysis should be carried out fairly early to ascertain continuity in the nerve.

Shaft fractures of the humerus should be amenable to treatment by means of intramedullary internal fixation, but, in our opinion, a mechanically acceptable device for intramedullary internal fixation in the humerus has not yet been devised, and the procedure is certainly not to be employed as routine treatment. Use of this method should, at present, be restricted to double fractures and the secondary fixation of compound fractures after the wound has been closed.

The most popular and talked-of method for treatment of fractures of the shaft of the humerus employs the so-called "hanging cast." We have not been able to appreciate the merits of this treatment. A hanging cast is never very comfortable, especially in the reclining position. If the cast is heavy enough to be comfortable in the upright position, the weight is likely to distract the fragments and delay or prevent union.

We have used hanging casts on several occasions but have always felt

that the fracture got well in spite of the treatment and not because of it. Any fracture that heals with a hanging cast will heal with any kind of treatment or with no treatment at all.

It is almost impossible to put on a shoulder spica that will adequately maintain fixation of a fracture of the shaft of the humerus. This is particularly true with heavy individuals. No spica cast of the shoulder is ever anything but misery for the patient who wears it.

However, there is a method of fixation of fractures of the shaft of the humerus which gives absolute fixation without distraction. The procedure can be used in any shaft fracture and is particularly useful in severely comminuted compound fractures. We have used this treatment many times and especially recommend it.

Basically, the technic consists of putting a Roger-Anderson half-pin unit, that is, two pins with a connecting bar, in the upper fragment, just below the head of the humerus or with the upper pin in the head. This unit and the entire arm and hand are then incorporated in a plaster cast. Every orthopedic surgeon knows that Roger-Anderson pins must be inserted slowly, so as to not produce a ring sequestrum from overheating of the bone.

A window may be put in the cast to allow access to a compound wound or to an operative incision without in any way disturbing the fixation. The shoulder has sufficient motion to permit the arm to be placed in a comfortable position.

A trial of this method will be very convincing. One pin in the upper fragment incorporated in the cast is not sufficient to immobilize the fracture properly and suspend the cast.

ELBOW JOINT

Probably all fractures of the lower end of the humerus involving the elbow joint which show gross displacement of fragments should be openly reduced, whether simple or compound.

Fractures of the upper end of the humerus and shaft fractures of the humerus are comparatively rare in children; fractures of the lower end of the humerus, particularly supracondylar fractures, are fairly common. Supracondylar fractures in young children do quite well even if they are not reduced.

Manipulation, under anesthesia, consisting of slight extension to break up impaction, followed by traction and flexion in that order, usually produces a satisfactory position.

These fractures should not be put up in too much flexion because of the possibility of interference with circulation. This warning has been mentioned many times, but Volkmann's ischemic contracture still occurs with dismaying frequency. A close watch must be maintained during the first few days and, if any signs of circulatory disturbance appear, the elbow should be extended and all medical and surgical effort directed toward restoration of circulation.

Fractures involving the elbow joint surfaces of the humerus should be openly reduced even in children. This opinion has been drawn from a number of recent experiences in which the actual damage to the elbow joint in fractures of the lower

humerus in young children was found, at open operation, to be much more extensive than that anticipated from examination of the roentgenogram. Many of the bad results obtained in young children in fractures into the elbow joint could be avoided by recognition of this fact and use of open reduction.

Open reductions of severe fractures of the lower end of the humerus in young children are followed by much more gratifying results than those attained after similar injuries in adults. Open reduction of simple and compound fractures of the lower end of the humerus in adults may also require subsequent external fixation.

If so, the fixation method described for fractures of the shaft of the humerus may be used to advantage. The procedure has the additional benefit of absolute immobilization of soft parts; this, in severely contused fractures, can be very important.

The application of woven elastic—not rubber elastic—bandage to the arm before the cast is put on will do much to prevent swelling and has a beneficial effect on circulatory efficiency. In severe cases, prophylaxis for arterial spasm should be carried out by using papaverine in adequate dosage. Priscoline may be started when shock is no longer a factor.

The length of immobilization in fractures of the elbow is extremely important and in most cases some motion must be instituted not later than three weeks after injury if a satisfactory range of motion is to be obtained. The relaxed, loose-jointed individual gets a good range of motion. In the tight-muscled, tight-jointed person, comparable results are not to be expected.

A conservative approach is advisable to debridement of the severely comminuted compound fractures of the elbow joint, such as are sustained in side-swipe injuries. All possibly viable fragments of bone should be left in place; pieces that do not survive can always be removed later. Only as much soft tissue should be removed as is necessary to secure a clean wound.

If marked limitation of motion results, increased motion can be obtained by resection of the lower end of the humerus. However, this procedure is always done to the detriment of stability, and the disadvantages must be determined on the merits of the individual case.

BONE PRESERVED FOR GRAFTING by refrigeration can be used in rhinoplasty. The homogeneous cancellous material may be taken from the iliac bone of a fresh cadaver or saved from a spinal fusion operation. Col. A. J. Vadala, M.C., and Lt. Col. Kenneth Somers, M.C., of Fitzsimons General Hospital, Denver, use a 1:5,000 solution of zephiran for preserving the bone at a temperature of 35 to 40° F. The specimen is cultured once a week for three weeks and again a few days before use. Bone may be preserved for as long as four months in this manner.

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Fractures of the Elbow Joint

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Prepared for Modern Medicine

GENERALLY, by the time the patient with a fracture about the elbow joint arrives at the physician's office, there is marked swelling of the surrounding soft parts.

By careful palpation and comparison with the opposite elbow, the physician can determine the relationship of the condyles and the olecranon. Such examination is of particular aid in differentiating a dislocation from a fracture. Immediate check is made upon the radial pulse and upon the sensation and motor power of the ulnar, radial, and median nerves.

Direct steps should be taken to immobilize the elbow to prevent further damage to surrounding soft parts. An anterior or posterior molded plaster of paris splint is used. The patient is then sent for roentgen examination.

The roentgenograms must be made with the arm immobilized to prevent damage to vessels and nerves. The anteroposterior film is difficult to interpret unless separate ones are taken of the distal humerus and proximal radius and ulna. A lateral film should be readily obtainable, but the degree of supination or pronation of the forearm must not be disturbed.

If reduction of the fracture does not restore the radial pulse, open surgery must be done. Division of the lacertus fibrosus between the biceps brachii and the pronator radii teres usually relieves the constricted artery.

At times, the brachial artery will be in spasm. It then may be necessary to strip the artery of its sympathetic supply. Failure to observe a vascular complication results in a tragic Volkmann's deformity or loss of the hand.

Reduction of the elbow fracture is usually facilitated if swelling is minimum. Therefore, reduction is best accomplished within the first hour or two, or else some days later, after immobilization in an elevated position has resulted in subsidence of the swelling.

Seven sites about the elbow joint are prone to fracture. Supracondylar fractures are the commonest. They are most frequent in children of three to seven years of age as the result of a fall upon the hand with the arm outstretched and the elbow extended. Figure *a* shows how the brachial vessel may be compressed

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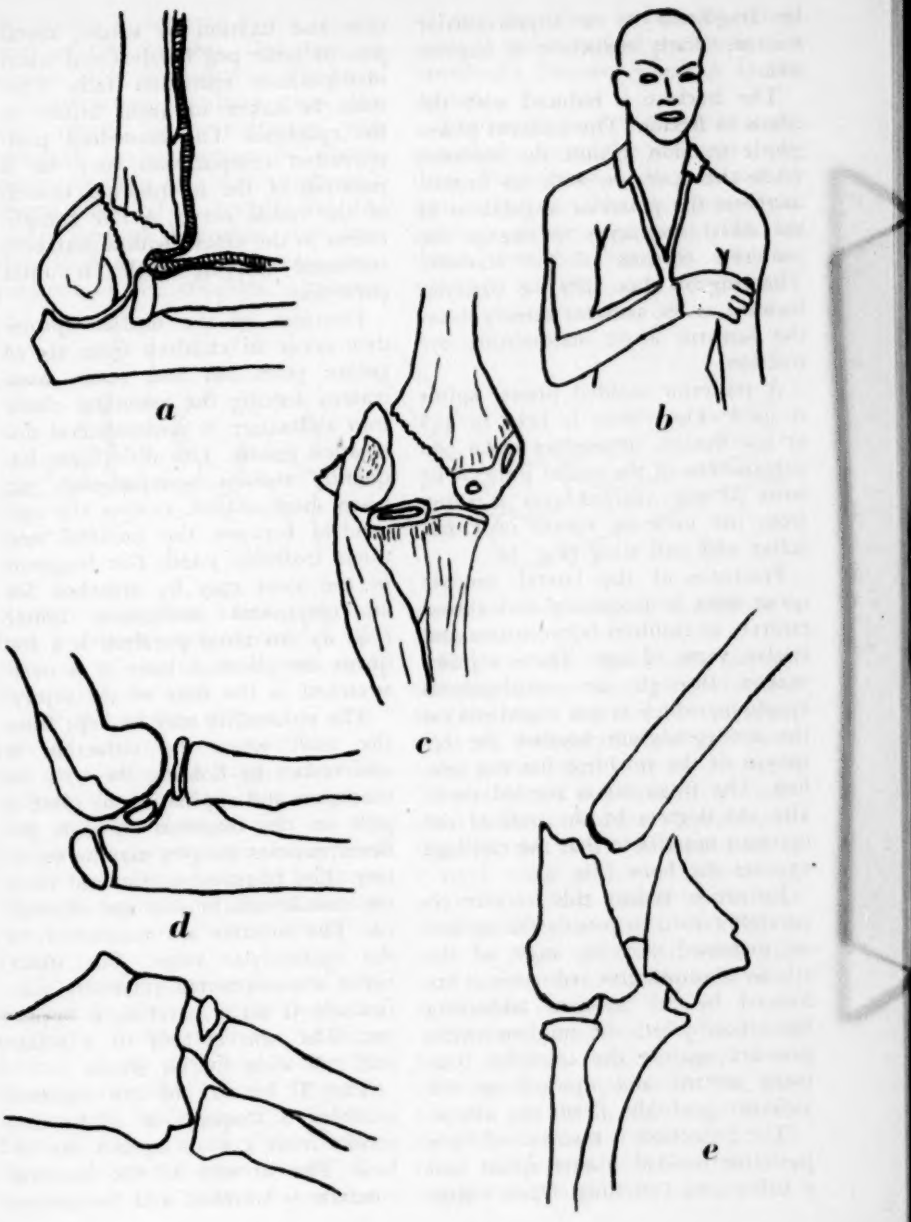

a
b
c
d
e

by fragments of a supracondylar fracture. Early reduction is imperative.

The fracture is reduced with the elbow in flexion. The assistant places gentle traction against the forearm, while the operator, with his fingers, increases the posterior angulation of the distal fragments to engage the posterior cortices of the fracture. The surgeon then lifts the condyles forward as the assistant acutely flexes the forearm while maintaining the traction.

A posterior molded plaster splint is used. The elbow is held in 45° or less flexion, depending upon embarrassment of the radial pulse. The wrist of the affected arm is slung from the neck by means of a felt collar and cuff sling (Fig. *b*).

Fractures of the lateral condyle occur next in frequency and almost entirely in children between two and twelve years of age. These injuries extend through the cartilagenous epiphysis, which is not visualized on the roentgenogram because the epiphysis of the trochlear has not ossified. The fragment is rotated medially 180 degrees by the pull of the extensor muscles so that the cartilage apposes the bone (Fig. *c*).

Failure to reduce this fracture accurately results in pseudarthrosis and an increased carrying angle of the elbow. Manipulative reduction is enhanced by the assistant adducting the elbow joint; the surgeon exerts pressure against the condylar fragment inward and upward, as the assistant gradually flexes the elbow.

The reduction is maintained by a posterior molded plaster splint and a collar and cuff sling. Open reduction and fixation by suture, metal pin, or bone peg is advocated when manipulative reduction fails. Care must be taken to avoid injury to the epiphysis. The immediate postoperative complication may be a paralysis of the interosseous branch of the radial nerve. A late complication in the elbow, with a markedly increased carrying angle, is ulnar paralysis.

Fractures of the medial epicondyle occur in children from six to twelve years old and result from trauma forcing the extended elbow into abduction. A posterolateral dislocation results. This dislocation frequently reduces spontaneously or, when manipulated, catches the epicondyle between the humeral and ulnar trochlear joint. The fragment in the joint may be mistaken for an epiphyseal ossification center (Fig. *d*). An ulnar paralysis is a frequent complication since it is overstretched at the time of the injury.

The epicondyle may be kept from the joint when the reduction is undertaken by holding the wrist in extension and supination to place a pull on the fragment through the flexor muscles. Surgery may be necessary. The fragment is dissected from the muscle attachments and discarded. The muscles are reattached to the epicondylar ridge. The ulnar nerve is transplanted anteriorly, particularly if ulnar paralysis is apparent. The arm is held in a collar and cuff sling for six weeks.

The T fracture of the humeral condyles is frequent in adults and results from a blow against the elbow. The breadth of the humeral condyles is widened and the articu-

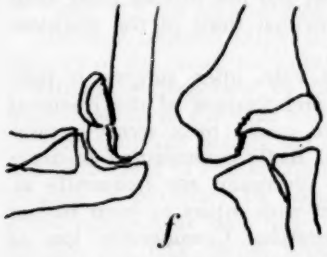
lar surface is distorted by the separation of the condyles. One type of displacement is shown in Figure *e*.

Conservative handling gives the best results; open reduction and anatomic approximation by screws, plates, or bolts as a rule produces a frozen elbow. The condyles are displaced forward. Therefore, after traction in extension and lateral compression of the condyles, a plaster cylinder is applied holding the elbow in about 120° extension. The wrist is suspended from the neck by a collar and cuff.

The dicondylar fracture or fracture of half of the capitellum occurs in adults. The fragment, which includes the front half of the capitellum and considerable part of the trochlea, is larger than it appears in the roentgenogram. A fragment displaced upward is shown in anteroposterior and lateral views in Figure *f*.

The manipulative reduction is facilitated by direct pressure with the surgeon's thumbs over the anterior surface of the fragment while the elbow is extended. If the fragment is displaced by flexion, the elbow is fixed in extension for four weeks. Open reduction is done if manipulation fails. The fragment is positioned and the elbow flexed. The fragment is never excised except in old unreduced fractures where it blocks flexion.

The radial head is fractured more commonly in adults than in children. The extended elbow is forced into valgus so that the capitellum splits or shatters the head. The internal condylar ligament may be stretched or torn, and at times a posterior dislocation of the elbow is associated.



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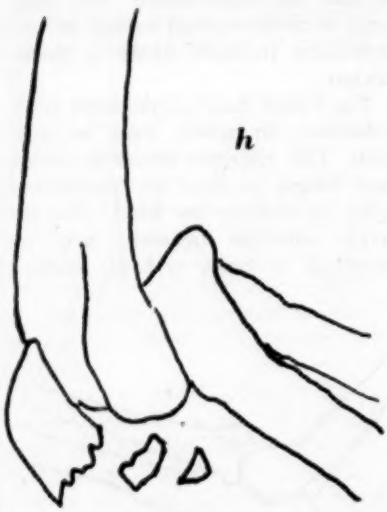
g

In every case, full-length forearm roentgenograms should be obtained to rule out a fracture of the ulnar shaft or a dislocation of the distal radial ulnar joint. If there is a crack fracture of the radial head or a marginal fracture without displacement (Fig. *g*), the elbow is supported at a right angle with an anterior or posterior molded plaster splint and a sling for two weeks. A sling is used for four additional weeks and light active exercises are performed at regular intervals.

Displaced fractures of the radial head demand surgical removal of all fragments of the head. The earlier the operation, the more favorable the outlook. Seldom is full range of elbow motion restored after radial head fractures, because con-



current damage has occurred in the capitellum and joint capsule.

Fractures of the proximal epiphysis of the radius in children are never excised. The head fragment, if displaced, is fitted back under direct vision at open operation.

Fractures of the olecranon with any displacement generally demand open operation and fixation (Fig. *h*). They can rarely be reduced or held by placing the elbow in full extension. Good results have been reported from excision of the olecranon and reattachment of the triceps tendon to the ulna when the olecranon fragment did not involve more than the proximal third of the trochlear notch.

As a rule, open surgery is indicated, and fixation of the fragment by wire suture or a screw is satisfactory. Badly comminuted fractures of the olecranon are frequently associated with injury to joint surface and condyles. Considerable loss of joint function may be expected unless the fragments are resected. Extensive resection of fragments may result in loss of triceps power.

Thorium-X for Ankylosing Spondylitis

P. PITZEN, M.D.*

PROGRESSIVE deformity, stiffness, and bony fusion of vertebrae are indicative of Bechterew's disease. The symptomatic treatment of this painful and protracted condition is often inefficient.

P. Pitzen, M.D., of Münster, Westphalia, Germany, for several years observed 15 patients with rheumatoid spinal arthritis. Previously unsuccessful physical therapy by heat and respiratory exercises was used with the addition of peteosthor, a drug containing thorium-X in a colloidal solution of platinum, with eosin-sodium as chemical stabilizer. Once a week, 5 cc. of the radioactive drug was injected intravenously; an average of nineteen injections per patient were given.

* Ueber die Behandlung des Morbus Bechterew mit Peteosthor. Med. Klin. 55:1111-1115, 1949.

Fractures of the Forearm and Wrist

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Prepared for Modern Medicine

FRACTURES involving wrist and forearm together constitute at least 20% of all fractures.

The most common carpal injury is fracture of the carpal navicular. This condition is diagnosed by lessened functional use of the wrist and hand, local swelling and pain in the carpus, and tenderness in the snuffbox. Verification is necessary by roentgenograms made in at least three planes through the true carpal area. The earlier the treatment, the better the prognosis; therefore all carpal injuries should be subjected to roentgen examination.

As soon as the diagnosis is made, if fragments are displaced and carpal dislocation is absent, gentle traction manipulation under anesthesia to slight dorsal and radial flexion of the hand is indicated. This reduction is followed by a checking roentgenogram to assure approximation of fragments while the hand is held steadily and quietly.

Immobilization is established by a lightly padded plaster of paris encasement. The encasement covers the thumb to its tip, the hand from the metacarpophalangeal joints, the wrist, and the forearm nearly to the elbow and must be worn at least seven weeks. Progress of bone healing may then be examined by x-rays through the plaster. If union is shown, the splint is removed.

If bony union does not seem to be taking place, the splint is removed, without moving the wrist, and a second roentgenogram is made. If no union is found, a second plaster encasement is worn for the same length of time. Carpal bones heal slowly; nonunion frequently follows fracture except in the distal row.

Fractures involving one or both of the forearm bones at the wrist nearly always cause obvious deformity, tenderness on pressure, interference with hand and forearm function, but may fail entirely to give crepitus on gentle manipulation. In fact, before Colles' description of the common wrist fracture of the radius, within an inch of the radiocarpal joint, the condition was considered a dislocation because of the rigid deformity and lack of crepitus.

If the deformity is gross, the doctor can usually make a diagnosis at a glance, simply by remarking the apparent comparative uselessness of the hand, loss of hand grip, disturbed relationship of the styloid processes of ulna and radius, local swelling, and tenderness to cautious pressure on the radius near the radiocarpal joint.

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The silver fork deformity clinches the diagnosis.

A roentgenogram confirms the fracture, usually of radius alone, but sometimes of both forearm bones or the ulnar styloid together with upward and backward tilting of the distal fragment of the radius. This fragment of the radius is often impacted into the diaphyseal portion of the bone, explaining the deformity, pain, and lack of crepitus which confuse the fracture with dislocation.

The doctor must assure himself that the hand has no nerve injury and that all tendons, especially those of the thumb, are intact.

Reduction cannot be performed too quickly after roentgen confirmation. The procedure may be done by manipulation of the hand under anesthesia. An assistant holds the forearm firmly while traction on the long axis of the forearm unlocks the fracture; and flexion of the hand and wrist, often ulnarward, lengthens out the radius, obliterating the silver fork deformity and restoring the normal relationship of the styloid processes of the radius and ulna.

Some difficult displacements are quite easily reduced by continuous traction on the hand, the forearm being flexed over a suitable padded bar; local anesthesia is used. Immediately after the reduction has been determined by roentgenograms, a plaster dressing is applied delicately without disturbance of fragments. After roentgen confirmation of reduction, a rather snug, lightly padded plaster of paris encasement should be applied from the base of the fingers to the lower part of the arm, covering the flexed elbow at right angles. Extra padding may well be applied over the styloid processes.

This encasement must be left on at least six weeks, when, on removal, considerable bony healing should be shown by the roentgenogram. In any event, a second supporting splint, dorsal or volar, molded of suitable material, should be worn for four to six weeks more to prevent recurrence or displacement. This immobilization will not interfere with final wrist function.

The finger joints are left free and are constantly moved during the splint-wearing period. When the splint is finally removed, the doctor should supervise after-care and frequently warn against forceful dorsiflexion of the wrist. Important are warm oil soaks of the hand, active manipulation of fingers, gentle massage of digital joints, and use of a golf ball for squeeze exercise. Enduring patience brings excellent results. Irreducible fractures should be referred as early as possible to a consultant.

Epiphyseal separations in adolescents may lead to growth stoppage. Parents should be warned that even after perfect reduction of displacements, this sequence may be unavoidable.

Fracture of the forearm bones in their shaft portions is difficult to discuss briefly. The following principles and objectives in treatment may be stated, however: [1] preservation of full length of the bone or bones involved, [2] correct axial alignment in all planes, and [3] sustained apposition of the fractured surfaces of the broken bone or bones to a point of complete bony union

without subsequent bowing from muscle pull or insufficient splint support.

After recovery, or bony healing, not only must the forearm be straight, but a reasonably normal range of pronation and supination in the forearm must be retained. This range influences the use of the hand and, if lost, may affect not only the fine motions of an artisan, but also the gross movements of a laborer. Consequently, the doctor must know the insertion and action of the pronating and supinating muscles before he can begin to understand the difficulties of holding a reduction of fracture of one or two bones which lie almost parallel in the forearm.

The primary action to remember is the action of the various muscles starting with the biceps brachii attached to the radial tubercle which supinates the forearm and is a quick flexor. The pronator radii teres, the supinator, which tends to flex the distal part of the fractured radius toward the ulna, and the pronator quadratus, just above the wrist joint, also demand full consideration.

Inasmuch as these fractures involve patients of all ages from the small child to the working adult, the injuries must be studied individually, not treated in a routine manner. All depends on the shortening, overriding, rotation, and angulation of the bone ends, especially when bones are fractured, their positions being influenced by the causative trauma and the spastic muscle pulls after injury.

Oblique and spiral fractures tend to slip out of reduction very easily because their surfaces slide on each other. Some transverse fractures, although reduced end to end, angulate and cause late secondary deformity, the result of muscle pull or an insufficient period of splint support.

The child by bone growth and adaptation may compensate for and readjust what was at first an incomplete reduction and only a fair anatomic result. The adult cannot be expected to do this. Consequently many patients of all ages have been operated upon with the hope of obtaining good anatomic result, with full length, lack of rotation, and correction of angulation of the bone or bones.

Operation is, however, not the method of choice in any case in which manipulation may bring about fair or good reduction. This applies especially to the growing child.

The type of operative fixation varies in different hands. Metal plates, fixation wire, bands, screws in oblique and spiral fractures, and intramedullary fixation by wires and metal pins are employed. Finally, on account of the high incidence of nonunion in this part of the skeleton, primary use of small onlay autogenous bone grafts is employed for some adults.

The surgical judgment of the operator must determine the method; only competent certified surgeons should attempt the work. Sometimes excellent operative work is performed from the standpoint of the restoration of length and position, and with first class asepsis, yet careless postoperative treatment and too short a period of splintage will spoil the outcome.

Even if aseptic healing is secured,

other complications may arise. Cross union may lock the bones so that pronation and supination are lost; excess callus may interfere with muscle or nerve action and cause prolonged disability. Many of these sequelae will follow even the most gentle and intelligent nonoperative treatment.

When one takes into consideration the increased chance for such occurrences from operative disturbance—tearing or loosening of periosteum with resulting unwanted new bone formation, and the development of scar tissue which may bind tissues abnormally together—one may well hesitate to operate upon these fractures unless careful clinical and roentgenologic studies have been made and the highest type of aseptic and technically perfect surgery is available.

Any trauma of sufficient power to cause these fractures must also produce some injuries to soft parts, together with the inevitable hematoma about the fracture site. All lead to some restraint of function and limitation of motion no matter what treatment is given.

Our therapy, therefore, must revert back to the points previously stated: restoration of length, overcoming of angulation or overriding or both, axial realignment of the two almost parallel bones, and correction in rotational displacement between the bone fragment ends. The old rule was that fractures of both bones of the forearm should be immobilized in supination; fractures of the middle third in midposition; and those of the distal third in mild pronation, to allow for relaxation of counteracting muscle pull, always considering restoration of length and a parallel position of the forearm bones as shown in the roentgenogram after reduction.

This reduction usually requires traction of varying degree in the long axis and, if possible, a setting up of the arm with the forearm flexed at a right angle, thus relaxing the influence of the biceps and making the splint-carrying position reasonably comfortable. The position is held by a lightly padded plaster of paris encasement from the axillary fold of the arm to the palm of the hand at the base of the fingers, with the wrist very slightly dorsiflexed. All fingers and thumb are open for interim motion during healing.

The plaster must be delicately applied and adjusted so that no subsequent extensive cutting away is required to relieve pressure points. An outside sling suspended from the neck carries the arm, but the patient is warned to move the arm freely and actively at the shoulder many times a day and to keep up constant finger joint exercises.

Feeling that residual disability was largely dependent on the amount of rotational displacement, and possibly falling back on that well-tried law that "the distal portion of a given fracture which is mobile must always be brought in line with the proximal fragment which is usually fixed," Evans[3] advised tuberosity-view roentgenograms to determine clinically the amount of rotation in any forearm fracture which might be corrected and rechecked to lessen disability and promote better results. To describe this I cannot improve on the words

of Knight and Purvis[2] in their excellent article on fractures of both bones of the forearm in adults:

> An anteroposterior view of the elbow joint is taken with the tube tilted 20 degrees toward the olecranon. The tip of the olecranon is placed one-third of the way along the plate, with the elbow flexed to 90 degrees, care being taken that both condyles of the humerus are at the same level. In attempting a manipulative reduction of the fracture, a comparative "tuberosity view" of the opposite elbow should be made, if there is any question as to the rotational position of the proximal radial fragment. Reduction of the fracture is then performed with the forearm in the position of rotation which corresponds to that of the proximal radial fragment, since the rotation of this fragment cannot be controlled, and the distal fragment must be brought into alignment with it; after the reduction, the forearm is immobilized in that position. If an open reduction is to be performed, in a case in which the radial fracture is comminuted, arrangements should be made for x-rays to be taken with a portable machine during the operation, should any question of rotational alignment arise.

In 41 patients treated by manipulation, Knight and Purvis found satisfactory results in 29% and unsatisfactory in 71%, with 5 instances of nonunion. Forearm bones are not solidly united until four and one-half to five months, and one of the greatest errors in treatment is too short a period of supportive splintage.

Open reductions in 20 cases using plate fixation showed satisfactory results in 35%, and unsatisfactory in 65%, with 3 instances of nonunion in the ulna alone. Onlay bone grafts gave good results.[2]

Let us hesitate then before hastily forcing operation upon patients with forearm fracture. If old principles are persisted in and used to their full intent, operation may not be required in a high percentage of such injuries.

If, upon consultation, an operation offers hope of a greatly improved end result, no one should block it, but the procedure must be performed by the right surgeon, in the right place, at the right time, and after films have been studied of other or manipulative efforts.

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Fractures of the Hand

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Prepared for Modern Medicine

THERE is no such condition as a simple fracture of a finger or thumb. These injuries must not be brushed aside lightly because the bone is small or seems unimportant.

Fractures of the fingers and metacarpals are the most common of all body fractures and the most poorly treated. They are usually the result of a direct trauma, such as comes from the moving parts of machinery, fist fights, and the like.

In an effort to prevent crippling hand deformities, Bunnell,[1] in 1945, made a plea for proper treatment in the immediate theaters of operation of the war. His advice applies equally well today. Briefly it is this:

Only the injured part of the hand should be splinted because the joints of the whole hand will stiffen if all members are included in the splint. In immobilization of an individual digit, the proximal finger joints should be flexed. In this position the lateral ligaments of the joints are taut and cannot shorten.

Roentgenograms should be made of all injured hands.

Most of the damage done to fingers and hands in the way of permanent deformity can be traced to wrong splinting or improper reduction. *No finger should ever be placed in extension for treatment of any fracture.* The old method of splinting, immobilizing, or treating fractured phalanges or metacarpals by keeping the finger in extension is contrary to all the physiologic principles of hand function and causes shortened joint capsules and ligaments, thus producing deformity in extension.

Another example of bad splinting is wrapping the whole hand over a roll of bandage for the fracture of one phalanx or metacarpal. The entire hand becomes stiff and painful, and other joints are limited in function. The same mistake has been made with the use of wire or pulp traction of fingers in extension. Tongue blades should be used to examine throats, not to splint fractured digits.

Anatomic reduction of proximal phalangeal fractures is imperative because these phalanges form the base over which the tendons move. If the fractures are angulated, the overlying or underlying tendons will become adherent to the callus, and finger motion, so vital to the function of a hand, is diminished or lost.

DIAGNOSIS

The diagnosis of an injury of a hand should be apparent, because the phalanges and metacarpals are

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easily palpated and the hand responds to any trauma by marked swelling, muscle spasm, immobilization, and pain. Accurate estimation of bony damage should be made by x-ray examination in every hand injury.

Immediate treatment consists of placing the hand in the position of physiologic rest—the position naturally assumed when a person's forearm and hand are resting on the table. The fingers curls so that each individual finger, when flexed, points toward the promontory of the carpal scaphoid bone. The thumb is swung around in internal rotation so that its tip contacts the tip of the index finger in a pinch position. The metacarpal phalangeal joint is flexed forty-five degrees, the proximal interphalangeal joint seventy to ninety degrees, and the distal interphalangeal joint forty-five degrees.

This position can be maintained by placing the hand over a curved aluminum splint, such as advocated by Mason and Allen,[2] or over a board splint that is properly built up with cotton wadding. However, this splint is primarily for immobilization until roentgenograms can be made and specific treatment instituted.

PHALANGEAL FRACTURES

Most of the fractures of the phalanges are amenable to treatment in the office if no angulation or displacement is present.

Fractures of the distal phalanges are usually the result of direct trauma which causes smashing or comminution and a profuse hemorrhage usually expands tremendously in the finger pulp. The increasing pressure causes intense throbbing pain. Release of the hematoma by drilling the base of the nail affords quick relief.

Only in a few instances is anything more than simple splinting in a position of physiologic rest required in this type of fracture. An exception occurs when the distal tuft of the phalanx itself is fractured and does not unite with the main part of the shaft, thus acting as a foreign body which has to be removed later.

A common type of injury, the so-called baseball finger, is a sprain fracture with tearing of a basal fragment of bone from the extensor surface of the distal phalanx by the extensor digitorum tendon. Suturing is difficult. The best immediate treatment is hyperextension of the distal interphalangeal joint with flexion of the proximal joint at 90°.

To overcome the retraction of the extensor tendon, the proximal interphalangeal joint is flexed. Immobilization is achieved by a plaster cast usually eight or nine layers thick, extending from the web of the finger to the tip. While the cast is drying, the patient can press the finger firmly against the table, thus keeping the hyperextension, or the surgeon can grasp the terminal joint between his thumb and index finger and actively extend it to the limit of this motion. Immobilization is maintained for a period of six weeks and must be continuous and uninterrupted.

Fractures of the proximal phalanx are more common than those of the middle phalanx. Either type, if not displaced, can usually be treated

with a simple, curved splint of five layers of collodion gauze dressing applied while the finger is held in slight flexion. Bent aluminum finger splints are commonly used. The splint is kept on for four weeks.

Roentgenograms should be made at the time of injury and after two and four weeks to check satisfactory maintenance of position.

The middle phalanx, though not displaced, may be buckled dorsally or volarly, depending on whether the fragment is proximal or distal to the sublimus tendon insertion. Any displacement in fractures of the proximal phalanx is volar. Anatomic reduction and maintenance are mandatory because of the finger's tendency to stiffen. This stiffness results from the fact that the flexor and extensor tendons are often bound fast to the callus of the fractured phalanx. This contingency accounts for the greatest disability in finger fractures.

Treatment of a fracture of either the middle or proximal phalanx with displacement is not an office procedure but should be done in the hospital. If the fractures of the phalanges unite with backward angulation, the finger will be robbed of flexion and a tight fist cannot be made. If the fragments unite in volar flexion, flexor tendon power is lost through involvement of the tendon in callus.

With displacement of the phalangeal fracture, the following treatment is used:

The wrist is dorsiflexed thirty to forty degrees to relax the extensor carpal muscles, securing muscle balance in a position of function. A cast is applied, extending to the volar flexion palmar crease and head of the metacarpals. After the cast is set, the fingers are flexed to relax the long flexor muscles and the interossei in physiologic position. The fracture is reduced by manual traction and manipulation in flexion.

The position is checked by fluoroscopic aid and, if anatomically correct in anteroposterior and lateral views, a wire splint is bent to fit the curve of the finger. A splint made of bent wire from a coat hanger is incorporated in the cast.

Traction, if necessary, may be maintained by skin pulp or skeletal traction. Care is taken to hold the fingers in a semiflexed position. That is, the metacarpal phalangeal joint is flexed about forty-five degrees, the proximal interphalangeal joint between seventy and eighty, and the distal interphalangeal joint forty.

Thus the traction pulls in a circular manner with the main apex drawing toward a hook by means of an elastic band. The hook is placed in the same line as the tubercle of the scaphoid. Only the finger in which the fracture occurred is immobilized. Every effort is made to keep the other fingers and thumb moving.

An ingenious operative method employing intramedullary pinning for the reduction and immobilization of fractures of the phalanges has been described by Brocq and Poilleux.[8] A direct incision is made over the phalanx and an intramedullary Kirschner wire, the exact length of the medullary canal, is inserted. These authors credit Lambotte with

the original intramedullary pin fixation, but claim that he damaged the interphalangeal joint by opening and drawing a pin through the articulating cortex. The method allows early motion.

METACARPAL FRACTURES

Most metacarpal fractures occur in men, usually as the result of a direct blow, as in boxing or fighting. The two most frequent sites are the base of the first metacarpal and the neck of the fifth. The neck fractures are usually from direct blows and present a posterior angular deformity.

Fractures other than these are caused by crushing from heavy objects or machinery and are frequently multiple, comminuted, and compound. Spiral fractures of metacarpals are produced by rotational forces.

Metacarpal fractures may be disabling in several ways. Malunion upsets muscle balance; a clawed finger results and the head of the metacarpal projects in the palm against the nerve so that the grasp is limited because of pain. Malunion or rotation makes the fingers deviate or cross on flexion. Adherence of the extensor and flexor tendon to the callus is also disabling. The interosseous muscles may be damaged and the tendons adhere to the firm parts beneath so that they cannot flex the proximal finger or extend the two distal digits.

The most common and troublesome complication is stiffening of the proximal finger joints in a straight position. This will happen if the fingers are splinted out straight so that the lateral ligaments become short and thick and do not allow flexion. When splinted in a flexed position, the ligaments remain long and leave the joints free to move.

In treatment of metacarpal fractures all the fingers should not be bound over a roll of bandage, a wood block, or the like. This therapy reduces the fracture but causes stiffness of the whole hand. Strapping the fingers to a flat splint or banjo traction with fingers in extension also produces a stiff hand.

A metacarpal fracture without displacement can be held by a forearm cast and wire loop keeping the finger in flexion. Application may be done in the office if there is no shortening or angulation.

A metacarpal fracture with angulation or shortening is reduced by traction and manipulation and the position is maintained by splint traction. A cast, preferably nonpadded, is applied to include the forearm and is molded against the metacarpals on the dorsum of the hand to the knuckles, dorsiflexing the wrist thirty degrees. Incorporated in the cast over the palm and wrist is a malleable extension wire curved to fit the volar surface of the finger, long enough for attachment of traction. A cord from the end of this to the wrist maintains the curve.

Bunnell[4] recommends the annealed iron wire loop popularized by Baylor. The curve is such that the proximal finger joint is flexed from twenty to forty-five, the middle to ninety, and the distal to about forty-five degrees. Too much flexion in the proximal joint cocks up the distal fragment; too little, allows the proxi-

mal joint to stiffen in a straight position. Thus the fingers are held midway in their range of motion and fractures have less tendency to displace.

Traction may be maintained by spiral adhesive plaster on the finger—the fingernail should be avoided—or by a steel wire loop or a pin through the finger pulp. For severe injuries, skeletal traction on the proximal phalanx is preferred, but care must be taken to drill through the head of the proximal phalanx and avoid the joint and dorsal aponeurosis.

An ingenious treatment of skeletal traction has been advocated by Quigley and Urist.[5] They describe the triangular space of the dorsal surface of the middle phalanx as the only area where skin directly overlies the fascia and bone; in this area, there are no structures which are necessary for motion. A small Kirschner wire is placed in a hole, previously made by a No. 6 dentist drill at an angle of four to five degrees; a little hook is placed into the traction wire and skeletal traction is thus obtained. Only the involved finger is placed on traction and the patient is urged to move the others freely.

With spiral fractures, this treatment may cause slight shortening but, according to Watson-Jones,[6] seldom interferes with function. Fractures near the neck of the metacarpals need continual traction, as do the Bennett type of fractures. Otherwise the fragments tend to lose apposition. Other methods of treatment, such as intramedullary wires, transfixion of a metacarpal to the adjacent one by means of fine Kirschner wire, and plate and screws, have been found useful.

In Bennett's fracture the fracture line passes obliquely through the base of the first metacarpal, detaching the greater part of the articular facet in a triangular fragment from the inner side of the base of the metacarpal. This fragment keeps its relationship to the great multiangular carpal bone, but the metacarpal is displaced or dislocated backward.

Traction is always used in therapy with a forearm cast and the thumb held in apposition, in internal rotation, not in abduction and extension. Bennett fractures are immobilized for at least six weeks. Malunion and arthritis with loss of thumb function are common sequelae of inadequate therapy.

COMPOUND FRACTURES

Compound fractures and dislocations must be treated at the hospital. Every effort is needed to prevent development of infection. This is only possible if the patient is seen within six to eight hours after the injury.

The wound should receive the same general care given any open lesion of the hand. As first aid, a sterile, protective dressing is put over the wound, a splint is applied allowing the wrist and hand to rest in a physiologic position, and the patient is sent to the hospital at once.

The history should be carefully elicited, a motor and sensory examination performed, roentgenograms made, and gas gangrene serum and tetanus antitoxin given. Antibiotic

drugs should be administered as indicated.

The patient is taken to the operating room where inspection and examination are done under aseptic technic. The skin and wound are cleansed with soap and water, then devitalized tissue is removed.

Conservatism should be practiced in the removal of bone fragments. Amputation is very rarely, if ever, performed, especially of the thumb. North[7] advises leaving the wound open. Most authors advise closing the lesion if seen within six to eight hours.

The wound is closed by sutures preferably without undue tension. If tension is present, free use of free skin or split-thickness grafts is usually indicated. Adjacent skin may be shifted over the bone and the area from which the flap has been shifted is covered with a split-thickness graft.

According to Mason and Allen[2] a compression dressing is most important for the preservation of function, since edema and swelling lead to fibrosis and stiffening. They advocate an aluminum splint which holds the hands in a physiologic position and allows wet compression dressings to be applied. Painstaking but gentle cleansing with soap, water, and cotton and the removal of foreign material and excision of all nonviable tissues will eliminate most of the bacteria. Immobilize only the injured member of the hand and encourage the rest of the hand to maintain its function.

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CORACOCLAVICULAR JOINTS, rare anomalies, can be successfully treated by surgery. F. J. S. Hall, M.B., of Victoria Hospital, Deal, England, describes a case of an abnormal outgrowth between the right clavicle and coracoid processes. The patient, a forty-year-old organist, had severe pain in the forearm for two years and had lost power of full and rapid pronation and supination in the arm. Through a linear incision along the middle third of the clavicle, the anomalous joint was found by careful dissection underneath the clavicle. An osteotome was applied to the base of the joint, which was split with about a dozen hammer taps and removed. Pain disappeared completely and in two weeks the patient was able to play the organ with ease. Slight limitation of rapid twisting movement of the forearm persists.

Brit. M. J. 4636:766-768, 1950.

Fractures of the Femur

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Prepared for Modern Medicine

FRACTURES of the femur usually result from direct violence incurred in occupational or traffic accidents. The majority happen during youth or early adult life.

Shock of some degree almost invariably accompanies fracture of the shaft of the femur because of the violence needed to break such a large bone and the major bleeding that occurs into the soft tissues of the thigh. Frequently the loss of blood is sufficient to require transfusion. Early, definitive treatment for the fracture is also good therapy for the shock.

Fractures of the femur may be conveniently classified into three groups as those occurring in [1] the subtrochanteric region and upper third, [2] the midshaft, and [3] the lower third or involving the condyles of the femur. Some of these have rather constant and characteristic deformities, the understanding of which facilitates treatment.

If the fracture lies just below the lesser trochanter, the short proximal fragment is flexed, because of the action of the iliopsoas tendon which attaches to the lesser trochanter, and is abducted by the action of the strong gluteal muscles which attach to the greater trochanter. In addition, the action of the short muscles which attach to the greater trochanter posteriorly may cause some external rotation (Fig. 1*a*).

If the fracture lies in the midshaft of the femur, the deformity is not constant; the fracturing force may drive the bone ends into almost any position. However, more or less shortening usually occurs because of the contraction of the muscles which cross the fracture line, and generally the proximal fragment is anterior and the distal fragment is posterior (Fig. 1*b*).

The two heads of the strong gastrocnemius muscle arise from the posterior surface of the supracondylar region. For this reason, in fractures through the lower third of the femur, the short distal fragment is almost inevitably displaced posteriorly a certain amount and contraction of the long thigh muscles produces some overriding (Fig. 1*c*).

Practically all fractures of the femur can be treated conservatively. The blood supply is generous, both from nutrient arteries within the bone and from the surrounding muscles. For this reason vigorous healing is the rule in the properly treated fracture and nonunion is seldom observed unless immobilization is grossly inadequate.

Malunion, however, may occur if

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the deforming forces of the muscles are not properly counteracted by traction in the opposite direction. Anatomic reposition is desirable but not required. The objectives of treatment are to restore full length and normal alignment. If the bone ends can be brought into even slight contact, union will occur and a good result may be anticipated.

In children, healing of fractures of the femoral shaft may take place with remarkable rapidity and the natural processes of bone repair may overcome even gross deformities. We should not, however, be content with any less perfect anatomic reposition in children than in adults, because a poor reduction and the resultant deformity impose compensatory alterations that may lead to unequal epiphyseal growth. As the time for epiphyseal closure approaches, the ability of the growing limb to compensate for residual deformities steadily diminishes.

The definitive treatment selected for a fracture of the femur depends on several factors, chief among which are the type and location of the fracture, the age of the patient, and the surgeon's experience and equipment.

The principal methods may be listed as follows: [1] continuous traction, either fixed or balanced suspension, [2] closed reduction and immobilization with plaster, [3] closed reduction by means of skeletal traction devices, followed by immobilization in plaster or devices for skeletal fixation, and [4] open reduction and internal fixation.

UPPER THIRD OF FEMUR

Fractures of the upper third of the femur are not common. They are most difficult to treat if the short proximal fragment is flexed and abducted. The long distal fragment, which can be maneuvered, must be brought into proper relation with the short proximal fragment, which cannot be controlled. Failure to do

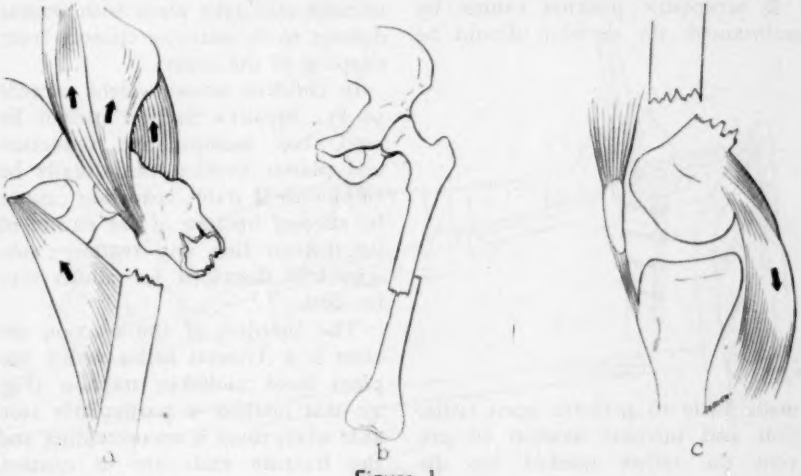

Figure 1

this will result in malunion, with sharp angulation at the site of fracture and shortening.

It may be possible to manipulate the limb into the necessary position of 45° abduction and immobilize it by the application of a double hip spica. If the fracture line is unstable, the strong pull of the adductors on the distal fragment may have to be counteracted by the application of adhesive skin traction underneath the plaster.

Alternatively, the fracture may be reduced by the pull of a Kirschner wire or Steinmann pin inserted through the femoral condyles or through the tibial tubercle followed by incorporation of the wire in the plaster spica. If the fracturing force, or the effect of muscle pull, has not produced appreciable deformity, it may be sufficient to immobilize in a double hip spica without prior reduction; careful watch must be made for any change in the position of the fragments.

If acceptable position cannot be maintained, the decision should be made early to perform open reduction and internal fixation to prevent the rather marked hip disability that results from union in the angulated position. The fracture fragments are reduced under direct vision through a lateral approach, and the reduction is maintained by the application of a long blade plate (Fig. 2).

Figure 2

MIDSHAFT OF FEMUR

Most of the fractures of the femoral shaft occur in the middle third; this portion of the bone includes the apex of the normal anterolateral bowing, and the exposed length affords greater access to the fracturing forces.

In infancy and early childhood the treatment of choice for this injury is Bryant's traction (Fig. 3). The injured leg and the well leg are suspended by means of adhesive strapping and counterbalanced by just enough weight to lift the buttocks from the bed. A restraining sheet over the abdomen is useful. The traction tapes must be watched carefully; if swelling occurs, pressure necrosis may take place with serious damage to the extensor tendons from slipping of the tapes.

In children whose weight exceeds 50 lb., Bryant's traction cannot be used, but manipulative reduction and plaster fixation can usually be employed. If stable reduction cannot be effected because of the nature of the fracture line, any treatment subsequently described for adults may be used.

The simplest of the traction devices is a Thomas splint which employs fixed moleskin traction (Fig. 4); this method is particularly suitable when there is no overriding and the fracture ends are in contact.

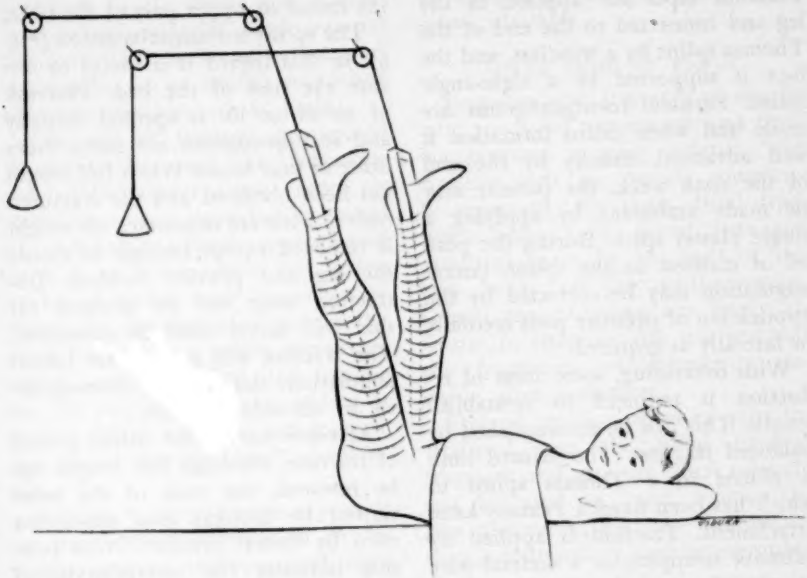

Figure 3

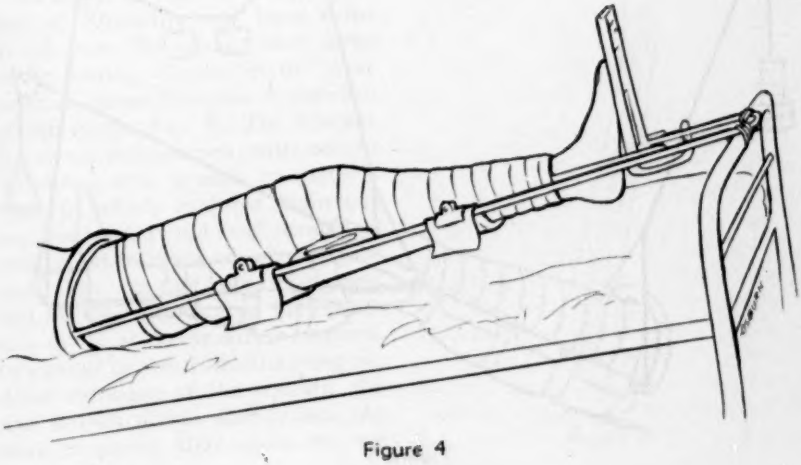

Figure 4

Traction tapes are applied to the leg and connected to the end of the Thomas splint by a windlass, and the foot is supported by a right-angle splint. Periodic roentgenograms are made and when callus formation is well advanced, usually by the end of the sixth week, the patient may be made ambulant by applying a single plaster spica. During the period of traction in the splint, lateral angulation may be corrected by the application of pressure pads medially or laterally as required.

With overriding, some form of reduction is required to reestablish length. This can be accomplished by balanced traction. The injured limb is placed in a Thomas splint to which has been fixed a Pearson knee attachment. Traction is applied by adhesive strapping or a skeletal wire or pin through the distal part of the femur or upper part of the tibia.

The splint is counterbalanced (Fig. 5); in this regard it is useful to elevate the foot of the bed. Traction of 20 to 30 lb. is applied initially and roentgenograms are taken every three or four hours. When full length has been obtained and the fractured ends of bone are in contact, all weight is removed except enough to steady the leg and provide comfort. Distraction must not be allowed for this will surely lead to nonunion. The traction will not correct lateral angulation; this must be accomplished by suitable splinting.

At times during the initial period of traction, although full length can be restored, the ends of the bone cannot be brought into apposition even by lateral pressure. As a rule, this indicates the interposition of muscular and fascial tissue between

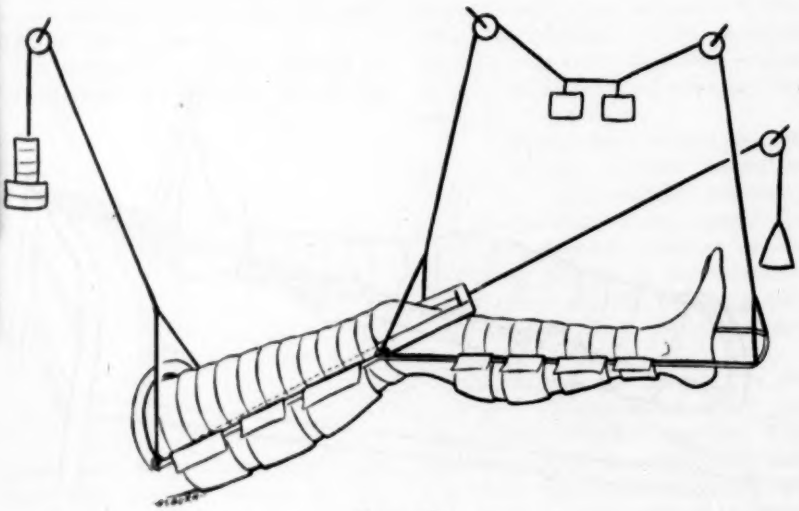

Figure 5

the ends of the bone and necessitates open reduction and internal fixation. This is a major surgical undertaking to be elected only when adequate facilities are at hand.

The site of fracture is exposed anterolaterally, and the fragments are reduced under direct vision; internal fixation is provided by means of transfixion screws supplemented by a 6- or 8-hole plate and screws or by an onlay graft secured with screws. In the case of a more transverse fracture line where transfixion screws cannot be used, the fixation can be provided by two plates or by one plate and one onlay graft, one placed anteriorly and one laterally.

Internal fixation does not provide for unprotected ambulation or for weight bearing before sound bony healing has occurred. The protection of a plaster spica or caliper brace is mandatory until clinical and roentgen signs of bony union are undeniable.

Recently the intramedullary nailing of Küntscher has been introduced into this country and seems to be finding a place in the treatment of certain fractures of the shaft of the femur (Fig. 6). The Hansen-Street diamond-shaped nail, or the clover-leaf nail, is used by some in cases in which multiple transverse fracture lines do not lend themselves well to other forms of internal fixation. The fracture site is exposed and the nail is driven up the medullary cavity of the proximal fragment to emerge in the trochanteric region. After reduction of the fracture, the nail is then driven distally into the distal fragment. Here again, the use of adequate external fixation also seems advisable.

LOWER THIRD OF FEMUR

Supracondylar fractures of the femur are quite uncommon and their management is most difficult. The fracture ends are usually completely separated, the short distal fragment being fully flexed into the popliteal space by the pull of the two heads of the gastrocnemius. Closed manipulations are rarely effective in reducing this fracture and the fragments are frequently unstable after reduction.

Skeletal traction wires or pins introduced into the distal femoral fragment and into the tibial tubercle can be used to exert traction in two directions (Fig. 7). The reduction is followed by roentgenographic

Figure 6

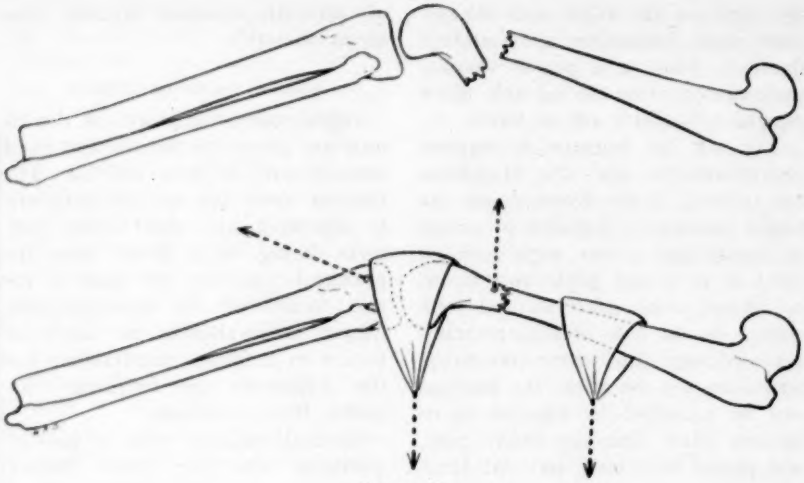

Figure 7

examination and, when the fracture ends are in anatomic apposition, a plaster spica incorporating both of the traction pins is applied. Insertion of the traction pin into the short distal femoral fragment is difficult, and care must be taken not to injure vital structures in the popliteal space.

At times the fragments will be incompletely displaced. In these cases it may suffice to place the limb in balanced traction, with the knee flexed to relax the pull of the gastrocnemius and traction exerted by adhesive tapes.

In any event, it is imperative to secure, and maintain, near anatomic reposition of supracondylar fractures. If union is allowed to occur with backward angulation at the fracture site, undesirable deformity will result and serious interference with function caused by genu recurvatum. If the above-described procedures fail to secure good reduction, open exposure is indicated. The fracture site is exposed laterally through the vastus lateralis and reposition is obtained under direct vision. A blade plate provides a convenient form of internal fixation (Fig. 8).

The fracturing force may drive the shaft of the femur downward, splitting the two femoral condyles apart, producing an intercondylar T or Y fracture. Here again, because the articulating surface of a weight-bearing joint is involved, anatomic reduction is important.

In fractures with minimal displacement, especially in elderly persons, satisfactory apposition may be obtained by adhesive traction supplemented by lateral pressure to mold the condyles into place. The lateral compression may be provided manually or by a heavily padded screw clamp. In younger patients, open reduction is more often indicated. Post-

traumatic degenerative joint changes are minimized by accurate reduction and internal fixation.

Abduction and adduction strains of the knee joint which frequently produce fractures of the tibial plateau may in rare cases give rise to fracture of one femoral condyle. Here, as with fractures of a portion of one condyle, the treatment of choice is open reduction and internal fixation.

Figure 8

Hyperextension injuries in childhood may result in separation of the lower femoral epiphysis. The epiphyseal fragment usually lies in front of the femoral shaft, carrying with it a fragment of the metaphysis over which it is displaced. Reduction can usually be accomplished by manipulation, and this should be done as soon after injury as possible to avoid damage to the neurovascular structures in the popliteal space.

Strong traction on the partially flexed knee usually brings the epiphysis down over the end of the shaft; the knee should then be flexed to 90° or more to seat the epiphysis fully in position. Any lateral displacement should be corrected by lateral compression.

After reduction, the pulse of the posterior tibial and dorsalis pedis arteries should be observed. Absence of pulse in these arteries and coldness or cyanosis of the limb indicate damage to the popliteal artery and call for immediate surgical intervention. If the peripheral circulation is unimpaired, the leg should be immobilized by an anterior molded splint with the knee in flexion.

REHABILITATION

From the standpoint of rehabilitation, perhaps the most serious sequel to fractures of the femur is stiffness of the knee. This may result from the effects of the fracture itself, as with adherent quadriceps mechanisms after fractures of the shaft, or from the effects of the fracture when the knee joint is involved directly, or from the method of immobilization.

In any event, active measures cannot be instituted to combat stiffness of the knee until the fracture is soundly healed or until the stage is set for sound healing to occur. In all cases quadriceps-setting exercises should be started early in order to maintain the tone of the anterior thigh muscles and to maintain mobility of the patella. The thighs of patients being treated by traction in balanced suspension can be passively exercised by the Pearson attachment. In the case of more refractory fractures which do not yield to physical therapy after long immobilization in plaster, some form of quadricepsplasty may have to be done.

Fractures of the Hip

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Prepared for Modern Medicine

JUDGMENT and skill of the surgeon are still challenged by fractures of the hip. Mortality is high, but progress in treatment has enabled many patients to enjoy the evening of their lives.

This progress has been largely due to improved x-ray technic and the discovery of inert metals. Nails, screws, lag screws, screw bolts, flanged nails, cannulated nails, pins, wires, and blade plates have been devised in such profusion that one might think the problem in treatment is to select the right gadget. Familiarity with modern methods of treatment and the availability of facilities are of secondary importance, however. Recognition of the type of fracture and of its effect upon the circulation of the proximal fragment and appreciation of the shearing forces which operate to favor union or nonunion are still of first importance.

A widespread misconception is that intertrochanteric fractures are not serious and always unite by bony union if the patient survives. Key[1] and others[2,3] have shown that, on the contrary, such fractures have a high mortality. All require a healing period of at least sixteen weeks, which is often beset with serious and sometimes fatal complications.

The usual classification of trochanteric fractures as basal, peritrochanteric, transtrochanteric, intertrochanteric, and subtrochanteric is valueless in planning treatment. The important point is to determine whether the fracture is stable or unstable. Evans[3] declares that "any fracture with cortical instability on one side, whether due to cortical overlap or cortical destruction, tends to collapse in the direction of the instability."

The choice of treatment in a particular case is governed by the general condition of the patient, the facilities available, the financial status of the patient, and the skill of the surgeon. Some patients should be treated conservatively despite the increased mortality rate and hazards of decubitus ulcers, mental deterioration, and pulmonary and genitourinary complications.

If conservative treatment is determined upon, traction in a Thomas splint or use of a well-fitting plaster of paris cast or a Boehler nail is the usual procedure. The well-leg traction splint is unsatisfactory because the patient is more uncomfortable and more confined than in traction. External pin fixation is to be condemned because of the too frequent complication of pin seepage.

Operative treatment with some form of internal fixation greatly reduces the mortality, should give better results, and requires a shorter healing time. Thrombophlebitis and pulmonary complications frequently occur after internal fixation, however.

Good internal fixation may be obtained with multiple pins and screws if the fracture is not badly comminuted. But most trochanteric fractures are comminuted and in such cases the blade plate, when properly introduced, will give excellent fixation. A curved or V-shaped blade seems to cut less than others into the cancellous bone of the femoral neck. When the blade is centered in the fragment of the neck, unstable fragments may telescope and allow the blade to perforate the head and traumatize the hip joint. Greater security can be obtained by driving the blade so as to impale the cortex of the neck. In these cases early motion is encouraged; weight bearing, however, is not permitted until radiologic evidence of solid union is noted.

In spite of improved x-ray technic and ingenious devices for internal fixation, intracapsular fractures still remain a challenge. Bony union *can* be obtained by closed methods—Leadbetter reduction, Whitman impaction, and double-spica cast. Intracapsular fractures are prone to avascular necrosis, whether treated by closed methods or some form of internal fixation.

Good roentgenograms are all important and must be studied carefully to determine the type of fracture and whether it is impacted. Per Linton[4] has emphasized that the "assumption that there is impaction depends upon close contact between the fragments, and reasonable stability." Clinically there should be freedom from pain on passive motion.

Unless an impacted fracture is in good valgus position and stable, it should be fixed internally. The prognosis for bony union depends upon the angle the fracture line makes with the horizontal. According to Watson-Jones,[5] if the angle is less than 30° the prognosis for bony union is excellent; if it is from 30 to 50°, good internal fixation is required and the prognosis is fairly good. When the angle is more than 60°, the chances of survival of the head are small and some type of reconstruction operation should probably be performed immediately instead of an internal fixation procedure.

Threaded wires, Moore pins, screws, lag screws, screw bolts, flanged nails, and cannulated nails have all been used with success in treatment of intracapsular fractures of the hip; but all these devices require skillful craftsmanship and good surgical judgment. Perfect reduction and internal fixation with any type of gadget may not prevent avascular necrosis.

In 1933 the author[6] devised a screw bolt for introduction through the trochanter to compress the fragments firmly together. While successful in some cases, rotation of the head occurred in others; this was prevented by use of a pin. Further experience showed that the screw would not always hold in the cancellous bone of the femoral neck, and the principle was abandoned.

A Smith-Petersen nail between two guide pins, which prevent rotation of the head while driving the nail, has given best results. A protractor is placed on the roentgenogram of the sound hip to find the angle of the femoral neck, and the length of the nail is also estimated. After the fracture has been reduced by the Leadbetter method, two pins are introduced from the trochanteric side with a hand chuck at the angle and distance estimated from the roentgenogram of the sound hip. If anteroposterior and lateral films show good reduction and the pins in good position, the Smith-Petersen nail is driven between the two pins which steady the head and prevent rotation during the maneuver. Care should be taken to drive the nail in an upright, letter Y position. The broad limbs of the flanges do not cut the cancellous bone, as the single flange may if the nail is driven in an inverted Y position.

One pin is left beside the nail to improve stability, and the second guide pin is withdrawn. Wide exposure of the fracture site and nailing under direct vision may be more accurate but require more extensive surgery, increase the risk of the operative procedure, and are unnecessary.

Despite good reduction and good internal fixation, avascular necrosis of the proximal fragment often occurs. When the roentgenogram shows evidence of absorption of the neck and necrosis of the head, some form of reconstruction operation should be considered if the condition of the patient will permit such additional surgery. Many types of reconstruction have been devised and all have given good results. They resolve into two types: those which attempt to preserve the head, and those which discard the head and utilize the reshaped neck with transplantation of the insertion of the abductors. If the head seems viable and fairly sound and the patient is a good surgical risk, the author prefers the Luck type of reconstruction.[7]

For patients crippled by nonunion who must accept the quickest and most certain procedure to regain a painless, stable hip, the Whitman reconstruction is the operation of choice. It is quick, sure, and takes the shortest time to heal of any type of reconstruction. The patient is left with some shortening and limited motion but has a reliable extremity for weight bearing. The objection to this operation is that few patients regain enough hip flexion to enable them to put on their own shoe, but a long-handled forceps may overcome this objection.

The important point in a Whitman reconstruction is to reimplant the abductors securely lower down upon the femoral shaft.

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Fractures of the Knee Joint

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Prepared for Modern Medicine

FRACTURES of the knee constitute a considerable proportion of the skeletal injuries seen in any fracture ward.

In any consideration of such fractures, the role of the ligamentous structures must be kept in mind. The ultimate objective is the restoration of structural relations at the joint and the preservation of joint motion. This calls for the highest ingenuity and skill.

The great forces affecting the structures of the knee joint as a result of the long levers formed by the femur and tibia, combined with the cancellous character of the condyles of both bones, result in a wide variety of lesions. Fractures, lesions of the menisci, and ligamentous ruptures cannot be dealt with as entirely separate entities, for all these structures are involved to greater or less degree in any trauma to the knee joint.

When the knee is extended to 180°, the posterior ligaments, the medial and lateral collateral ligaments, as well as the cruciate ligaments, are tense and the leg is rigid. Sufficient force applied medially, laterally, or posteriorly will result in the disruption of the resisting ligamentous structures, avulsion from their attachments, or actual fracture of the bony structures of the knee joint.

Fractures of the knee may be simple, comminuted, single, or multiple and may be compounded. The presence of a fracture about the knee joint usually indicates that the ligamentous structures have withstood the insult causing the cancellous bone to yield through the line of fracture. This fact is of importance, for the ligamentous attachments to the bony fragments afford control which would be lacking were the ligaments ruptured. In most cases, the type and direction of the fracture indicate the direction of the fracturing force.

Fractures involving the distal portion of the femur may be classified as supracondylar, medial condylar, lateral condylar, intercondylar or T, and epiphyseal.

The *supracondylar* fractures result from forces hyperextending the knee joint or from direct trauma. The condyles of the femur are rotated posteriorly (Figs. 1A and $1A_1$) and held in this position by the strong action of the gastrocnemius muscle.

The condylar portion of the femur is short and can be reduced only by the application of indirect forces

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through the joint. The tension of the gastrocnemius muscles is reduced by flexion of the knee, and traction is applied through the ligamentous structures attached to the tibia by a flexed knee brace, skin traction, or skeletal traction.

Fractures of the *medial condyle* (Fig. 1B) extend from the intercondylar notch through the thin cortex at the base of the condyle on the medial surface of the femur. The size and position of the fragment vary considerably.

The medial collateral ligament is intact. This affords a means of applying traction to the displaced fragment by forcing the knee into a position of knock-knee. Considerable difficulty is encountered in approximating the fragment to normal position at the line of fracture. Fixation by means of screws, wires, or bolts is desirable. Should nonunion or softening of the fragment result, a progressive bowing of the leg may be expected.

Fractures of the *lateral condyle* (Fig. 1C) are similar to those of the medial condyle with the causative and corrective forces reversed. Nonunion or aseptic necrosis of the fragment is more disastrous, for normally the weight bearing through the lateral aspect of the knee exceeds that through the medial. A failure of complete reduction or repair increases the knock-knee deformity. Internal fixation of the fragments and protection of the healing fracture by a brace are essential.

The *intercondylar* or T fracture (Figs. 2D and $2D_1$) combines the features of the foregoing less complicated condylar lesions. The condyles are forced apart and rotated posteriorly. Fortunately, the collateral ligaments are intact and some control of the condylar fragments is possible by traction on the tibia or lower leg. Approximation of the fragments and closure of the T by a lug bolt are desirable.

Injuries to the lower femoral

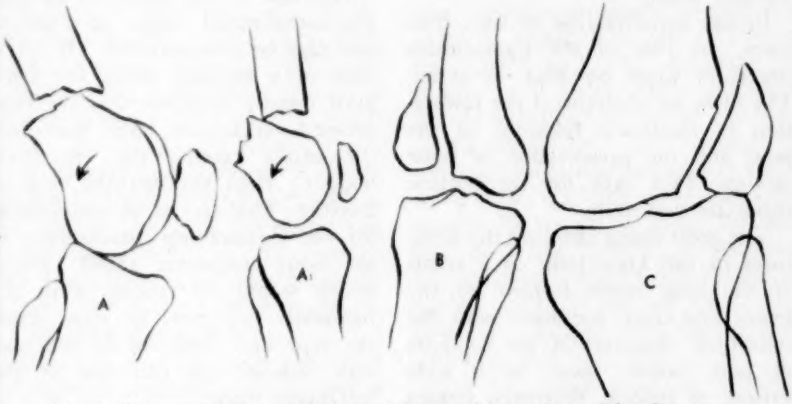

Fig. 1. Supracondylar, medial condylar, and lateral condylar fractures

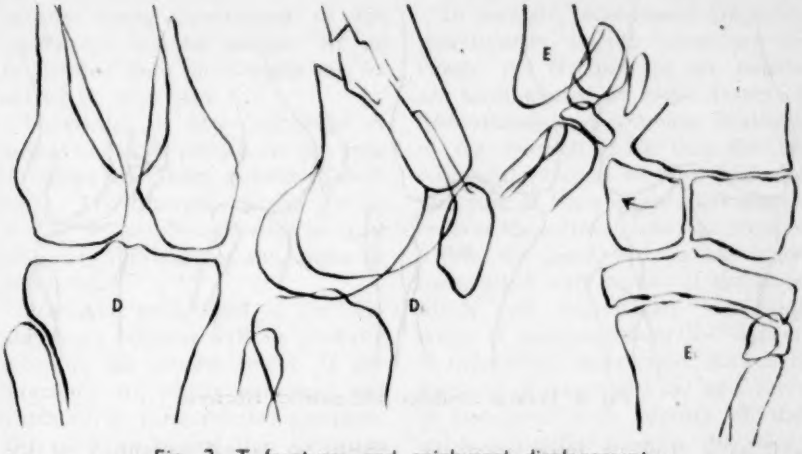

Fig. 2. T fractures and epiphyseal displacement

area occurring before epiphyseal closure often result in *epiphyseal* displacement, epiphyseolysis (Figs. 2E and $2E_1$). The lines of fracture follow the softer cartilaginous plate with or without fractures of the base of the condyles. The treatment of these various displacements is similar to that in the mature bone except for the real possibility of arrest of growth because of epiphyseal damage. If the epiphyseal damage is limited to but a portion of the growth plate, arrest of growth will be asymmetric and either bowleg or knock-knee deformity will result from the continued growth of the intact portion (Fig. 3F).

Fractures of the tibial condyles are more varied than those of the femur and are more apt to be complicated by traumatic lesions of the menisci. The convex surface of the femoral condyles acts as a wedge as

Fig. 3. Knock-knee deformity and medial condylar fracture

Fig. 4. Lateral condylar and patellar fractures

well as a crushing force upon the slightly concave articulating surfaces of the tibial platform.

These fractures may be classified as medial condylar, lateral condylar, intercondylar or T, posterior marginal, and comminuted.

The *medial condylar* (Figs. 3G and $3G_2$) and *lateral condylar* (Figs. 4H and $4H_1$) fractures result from forces similar in character to those acting on the condyles of the femur. They are more apt to be complicated by lesions of the menisci and of the articular fragments, both of which may be driven into the fracture line and prevent replacement of the fragments.

Arthrotomy and removal of the displaced meniscus or articular cartilage fragments are often necessary for anatomic restoration of the shattered bone. Normal alignment of the articular surface is essential and open reduction should be done if closed manipulation fails to accomplish good reposition of the fragments. Healing with malalignment of the upper surface of the tibia results in lateral instability of the joint and lateral or medial angulation at the knee.

Fixation of spreading fractures is possible by the use of bolts and fixation of smaller fragments by means of screws or wire. In old fractures, in which the articular surface remains depressed below the joint line, osteotomy of the fragment and restoration of the articular surface are indicated.

Fractures of the tibial condyles are occasionally limited to the posterior margins of the articular surfaces. These fragments are somewhat cuneiform in shape. If a large portion of the weight-bearing surface is involved, re-placement and fixation of the fragment of bone are essential.

Bony repair of fractures of the femoral or tibial condyles is slow and external support by means of a well-fitted brace will permit earlier mobilization of the knee joint, so essential for function.

Fractures of the *patella* (Figs. 4I and $4I_1$; Figs. $5I_2$ and $5I_3$) result from direct trauma or from an un-

usually strong contraction of the quadriceps femoris muscle. In all probability both mechanisms are involved in most cases.

Superficial or deep abrasions or lacerations often complicate this type of injury and delay definitive treatment. The fracture of the patella is most frequently transverse in type, involving the body or the upper or lower third.

Fractures with little or no displacement respond well to posterior splinting for several weeks. If the fragments are widely separated and displaced in their relative positions, it is well to assume that extensive tears of the aponeurosis of the quadriceps muscle are present. Open reduction is indicated.

Apposition of two major fragments may be obtained by fixation with a wire loop supplemented by suture of the aponeurosis medially and laterally. Should the fracture result in a large and small fragment, excision of the latter facilitates repair.

In severely comminuted fractures, patellectomy is the procedure of choice. All fractures of the patella are accompanied by some degree of hemarthrosis and synovitis. Drainage of the synovial space into the intermuscular layers of the thigh by puncture of the suprapatellar pouch reduces the effusion and the tension within the joint. A long leg brace constructed with a joint at the knee which will permit an increasing range of motion lessens the danger of quadriceps contracture. Although fractures of the patella are only rarely associated with rupture of the rectus or patellar tendons, this possibility must be kept in mind.

Fractures of the tibial spines (Figs. 5J and $5J_1$) indicate avulsions of the area of insertion of the cruciate ligaments. An increased anteroposterior mobility of the tibia on the condyles of the femur results. In case of minimal displacement, healing will be satisfactory. Should the fragment be greatly displaced, replacement or excision is indicated.

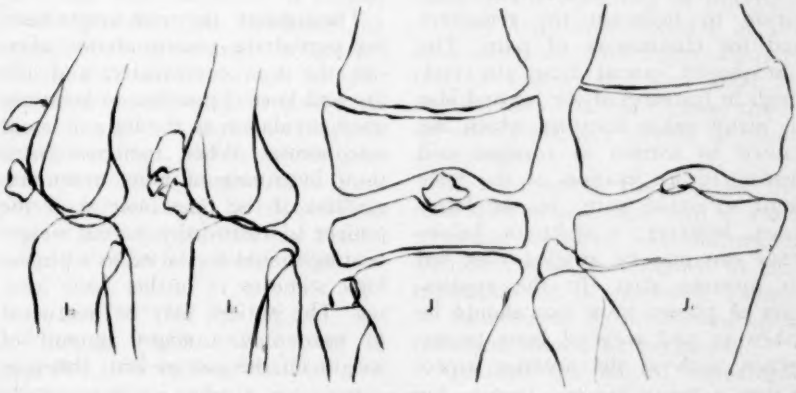

Fig. 5. Fractures of the patella and of the tibial spines

Fractures of the Leg and Ankle

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Prepared for Modern Medicine

In all fractures of the leg and ankle the goal of the physician is to restore normal function in a weight-bearing extremity. Prolongation of disability is caused more often by haphazard after care than by any error of reduction.

Limping, limited motion, persistent edema, stasis ulcers, and pain very often result from lackadaisical management after the fracture has been reduced. Careful supervision of the patient will not correct an error of reduction but will eliminate many poor results in cases with excellent reduction. For this reason, after care will be discussed first.

CARE AFTER REDUCTION

Plaster casts are used for immobilization to maintain the reduction and for elimination of pain. The cast should extend from the mid-thigh in fractures of the leg and also in many ankle fractures which are caused by torsion or rotation and hence require fixation of the knee joint to avoid pain. In the latter cases, however, a short or below-knee cast may be applied after ten to fourteen days. In the application of plaster casts, care should be taken to pad areas of bony prominence, such as the anterior aspect of the knee, head of the fibula, or malleoli at the ankle, and a long piece of felt should cover the sole of the foot and posterior aspect of the heel.

All casts should be trimmed to allow full motion of the toes, and the toes should be mobilized and exercised as assiduously as the fingers are in fractures of the wrist and forearm. Such exercise improves the circulation not only in the foot but in the leg and helps to prevent edema. The plaster on the sole of the foot should not extend to the tips of the toes; this practice inhibits exercises of the toes and often causes deformity that makes subsequent wearing of a shoe very uncomfortable.

Throughout the non-weight-bearing period the patient should exercise the toes continually, and the hip and knee if possible, to maintain good circulation in the leg and avoid osteoporosis. When roentgenograms show beginning of bony union, regardless of the time interval, if the patient is trustworthy, partial weight bearing should be started as a physiologic stimulus to further bone healing. The patient may be instructed to bear only a slight amount of weight on the cast at first; this may

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be increased, usually over a period of three to four weeks, to full weight bearing even without crutches.

Many excellent devices are available for application to the sole of the cast to facilitate weight bearing. The author prefers a walking heel applied to the center of the sole of the foot because this produces a stable walking surface and allows almost normal gait.

When sufficient bony union has occurred so that immobilization is no longer needed, the plaster encasement of the leg may be removed. The patient should be warned that considerable swelling will occur in the leg and ankle unless specific measures are taken. For the greater portion of each hour the patient should lie down and elevate his ankle and leg higher than the level of his heart; for the remainder of the hour he should walk upon the leg or at least exercise the knee, ankle, and toes.

Dependency of the leg without motion in an area of poor vascular tone causes extensive edema, aching pain, and delay in return of normal motion and function. Gradually the period of elevation may be shortened and that of exercise and ambulation lengthened until the patient is up and about without any appreciable swelling. Although this program becomes a burden to a busy physician and may be difficult to explain to some patients, the results make the effort very worth while.

FRACTURES OF LEG

When a fracture of the leg is suspected, roentgenograms in the anteroposterior and lateral views should be made to include both the knee joint and the ankle. With shorter films, a fracture of the head of the fibula or near the level of the ankle is not uncommonly missed.

Many simple fractures of the tibia do not require manipulation. The position is often quite satisfactory, with good bony contact and minimal, if any, angulation. Such fractures may be immobilized in a long leg plaster cast without anesthesia. A few will slip during the first week or so when some absorption takes place at the fracture site. For this reason a checkup roentgenogram through the plaster cast should be made after two weeks to ascertain good reduction.

If, however, displacement and angulation occur, manual manipulative reduction should be performed under anesthesia. Transfixion wires or pins for skeletal control are unnecessary and unwise unless soft tissue injury from hemorrhage, bruises, or other trauma is extensive. The os calcis should not be transfixed for prolonged traction because of the possibility of infection.

Many transverse fractures of the tibia and some with slight obliquity can be manipulated and good reduction obtained. Here again, checkup roentgenograms should be made at intervals.

In most spiral fractures of the tibia with displacement and in some transverse fractures, a satisfactory reduction cannot be obtained by manipulation or, if obtained, cannot be maintained. In these cases open reduction should be performed.

Although the use of transfixion wires or pins above and below the

fracture site with fixation in a manipulative machine or device may be satisfactory in very skilled hands, a general application of this method must be criticized. The danger of distraction at the fracture site and of fixation without the necessary amount of contact pressure is so great that many failures are inevitable.

Open reduction with use of a metal plate and screws must likewise be condemned. Screws alone provide better fixation. Moreover, because of the thin, soft tissue covering on the tibia, plates delay wound healing. Hairline, tight approximation of the fractured bone ends is practically impossible to maintain when plates are applied; the bone ends are actually held apart so that delayed union and nonunion are favored.

Mechanically, screw fixation alone draws the bone ends together and aids approximation. With a loose fragment or more than one fracture line, several screws may be used, perpendicular to the fracture surface. Even with transverse fractures, it is often possible to place one screw diagonally across the fracture and obtain excellent approximation of the bone ends and strong fixation.

Epiphyseal displacement and epiphyseal fractures can usually be reduced by manipulation, but must be completely reduced to minimize the possibility of growth disturbance.

Comminuted fractures of the tibia cannot be successfully managed by simple manual reduction because of a tendency toward shortening and angulation. Nor can open reduction and screw fixation be employed. In such cases, immediate bone grafting, proximal and distal skeletal fixation, and, in occasional cases, a metal plate may be indicated. Such procedures, however, should rest in the hands of an orthopedic surgeon.

Similarly, new methods of fracture management, such as the intramedullary nail, should be avoided by the occasional fracture surgeon until the safety and efficacy have been determined in recognized fracture centers. Indiscriminate use of metal plates, transfixion wires, and gadget hardware is condemned.

In compound fractures of the tibia, following debridement, irrigation, and penicillin therapy, the most important procedure is complete skin coverage of the wound. Definitive bone procedures should always be delayed if primary skin coverage cannot be obtained. A shifting skin graft may be used to cover the tibia, and a split-thickness graft used on the defect thus produced. After the compound fracture has been transformed into a simple fracture, definitive management may be executed.

Fractures of the fibula alone, although seldom of great importance, should not be neglected. The fibular fracture usually can be easily manipulated and should be immobilized for two to four weeks for symptomatic relief of pain.

FRACTURES OF ANKLE

The region of the ankle is fascinating from the standpoint of an etiologic classification, such as [1] external rotation fractures, [2] abduction fracture–dislocations, [3] adduction fractures, and [4] vertical compression fractures. When first, sec-

ond, and third degrees are added to this classification, the average physician may become confused. He can, however, produce enviable results by applying a common system of management to all.

In fractures of the ankle the initial roentgenograms are very important and should be fully studied before any manipulation is attempted. Anteroposterior and lateral views of the ankle with the knee in slight internal rotation are essential. Oblique views may be necessary to determine the size of fractured fragments or the extent of tibial joint surface involved.

Since the ankle is a vital weight-bearing joint, the reduction must be almost perfect and a normal mortice restored. All casts for ankle fractures should be applied in neutral inversion and eversion and at 90-degree dorsal flexion unless otherwise indicated.

When only one malleolus is fractured, the treatment is relatively simple (Fig. 1). Since one malleolus

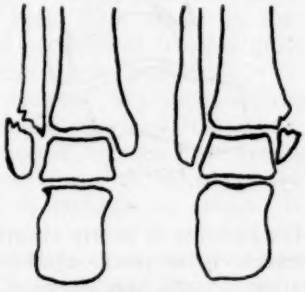

Figure 1

remains intact, the talus, even if displaced, may be moved against it by pressure on the fractured malleolus, so that perfect alignment with a normal ankle mortice is obtained. A below-knee cast should provide adequate immobilization.

In fractures of the medial malleolus, because of difficulty in obtaining bony union, advice is often given

Figure 2

to apply the cast with the foot in slight or moderate inversion. This is unnecessary and often harmful. When the cast is removed and the foot is returned to a neutral position, pain and disability almost inevitably result.

If the internal malleolus is not approximated with the foot in neutral position, it should be re-placed by open reduction and fixation with one small screw. Weight bearing may be initiated in three to four weeks. The prognosis in this group is good.

When both the internal and external malleoli are fractured and partial dislocation occurs (Fig. 2), reduction is more difficult. A point of stability must be established externally. The physician may lay the palm of one hand along the inner and lower aspect of the tibia extending over the medial malleolus but not onto the foot and establish the normal bone curvature of this

area; the other hand is then compressed against the tip of the fibula and the foot, while the sole of the foot rests upon the physician's chest, maintaining 90 degrees of dorsal flexion. The pressure must be continued while the plaster is setting.

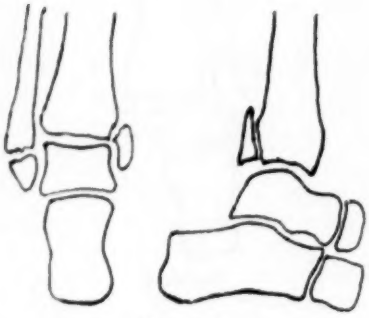

Figure 3

If roentgenograms do not show complete reduction, the procedure should be repeated. Occasionally, widening of the ankle mortice persists and must be reduced by screw fixation of the distal fibular fragment to the tibia. As the swelling diminishes the cast will provide less immobilization, and roentgenograms should be made to insure continued reduction; reapplication of the cast may be necessary. Tibiofibular diastasis with widening of the ankle mortice should always be looked for on roentgenograms, even if fractures are not present. Manipulation usually is successful, and screw fixation is worth while if manipulation fails.

When the internal and external malleoli are fractured and also the posterior projection of the tibia (Fig. 3), the term trimalleolar fracture is often used. This condition may be treated as in the preceding group, except that general or spinal anesthesia is used to relax the calf muscles.

By dorsal flexion of the foot, the posterior fragment can be brought down to the level of the joint surface. This fragment is usually small. When it involves one-third or more of the joint surface, open reduction is indicated to avert subsequent traumatic arthritis.

The most disabling fracture of the ankle is the vertical compression injury which either comminutes the anterior tibial joint surface or breaks off a large bone fragment (Fig. 4). The tibia is posteriorly displaced on the talus, and compression at the fracture site maintains the dislocation. Results are seldom good.

Figure 4

Manipulation is nearly always unsuccessful. In all such injuries consultation should be obtained. In some cases open reduction will be advisable and a serviceable ankle can be preserved. In others, however, immediate arthrodesis may shorten the disability period considerably.

Fractures of the Foot

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Prepared for Modern Medicine

In this increasingly mechanized and mobile civilization, fractures of the foot are of extreme economic importance.

Because the bones are small, external disfigurement often slight, and the mortality insignificant, treatment is frequently inadequate. Much disability results from the casual treatment that is often afforded these fractures, yet the economic importance of the foot is second only to that of the hand.

OS CALCIS FRACTURES

Fractures of the os calcis are generally caused by a fall from a considerable height, the main thrust of the fall being taken directly over the heel. The trauma to the soft parts of the heel is often quite important in the end result.

Treatment and prognosis depend upon the severity of the injury and the type of fracture. Axial roentgenograms of the os calcis are mandatory in addition to routine lateral views.

Fractures of the tuberosity and of the sustentaculum tali present the simplest problems. They are often in good position and require no treatment other than a snug-fitting plaster of paris cast from the knee to the toes. Any displacement can usually be corrected by local pressure directly over the fractured area under novocain anesthesia.

Fractures of the sustentaculum tali require six weeks of immobilization, and weight bearing in a cast may be permitted. If the line of fracture through the tuberosity is such that weight is borne at an angle to the fracture, weight bearing should be deferred for approximately six weeks, and ten to twelve weeks of immobilization may be necessary. The final test of union is, of course, made by roentgen studies.

Because of the extreme trauma associated with fractures of the os calcis, reduction is often inadvisable until the edema has subsided enough to enable one to identify the bony landmarks. Swelling often reaches such proportions that the entire skin surface over the foot and ankle blisters. If the foot is much swollen when first seen, a pressure dressing is applied and the foot elevated.

Reduction of a fracture of the os calcis cannot be maintained without adequate skeletal fixation. Tenotomy or lengthening of the tendocalcaneus should probably never be done in association with treatment of any os calcis fracture.

Comminuted fractures of the os calcis with involvement of the sub-

astragalar joint present a most serious problem and almost invariably leave a permanent disability, often necessitating a change of occupation. The residual disability is primarily due to one or more of the following common complications:

- Valgus of the heel and depression of the longitudinal arch, producing a flatfoot deformity often accompanied by peroneal spasm.
- Subastragalar arthritis due to incongruous or aseptic necrosis of joint surface. This produces painful limited motion in the subastragalar joint which is most pronounced when walking on a slope or on uneven ground.
- Painful limitation of motion in the midtarsal and toe joints. This may be due to adhesions as the result of edema and immobilization, to bone atrophy, which is frequently extreme and acute, or to a flatfoot deformity which progresses to a typical spastic flatfoot with generalized arthritis of the foot.
- Painful bony mass over the lateral aspect of the os calcis in the immediate vicinity of the distal end of the fibula. A flake of lateral cortex bone is detached and may result in a painful, thickened mass.
- Soreness of the soft tissues of the heel. This may result from disuse atrophy of the entire foot or from severe trauma to the soft tissues of the heel leading to atrophy and fibrosis of the infracalcaneal fat pad.

The multiplicity of technics recommended for comminuted fractures of the os calcis indicates the lack of any one satisfactory treatment of this difficult fracture; results of treatment by all methods are very much the same. Success by any method depends upon:

1] Sound bony union. This is easy to obtain, as the blood supply is excellent, the bone is largely cancellous in nature, and union is rapid.

2] Sound ankylosis of the subastragalar joint. A sound fibrous ankylosis which is painless is just as satisfactory as a bony one. However, a fibrous ankylosis is apt to be painful.

3] Restoration of normal foot posture. The valgus of the heel must be corrected and the posterior arch of the foot restored. Determination of the tuber angle as described by Boehler is perhaps the most accurate method of determining the adequacy of the reduction from the point of view of foot posture.

4] Full mobilization of all midtarsal and toe joints.

External skeletal fixation as advocated by Boehler and modified by others is perhaps the most satisfactory method of treatment. Two Steinmann pins are placed, one through the distal end of the tibia and another through the upper portion of the tuberosity of the os calcis. Strong traction is made upon the calcaneal pin, with countertraction on the tibial pin. At the same time, the fragments are compressed laterally by a C-clamp applied against well-padded skin over the sides of the heel.

After reduction is obtained, while traction is still being applied, a plaster of paris cast is put on, incorporating the pins. The knee need not be included.

After eight weeks, cast and pins are removed. A new cast is worn for four to eight weeks more. After twelve to sixteen weeks, union is generally adequate for weight bearing. Appropriate physical therapy and shoe corrections are described in the last section of this article.

Subastragalar arthrodesis or even

triple arthrodesis is often done for persistent, painful traumatic arthritis after healing is complete. Arthrodesis should probably be done early in the treatment of fracture of the os calcis if roentgenograms do not show adequate restoration of the superior articular surface. Triple arthrodesis may be necessary for much residual valgus of the heel and depression of the longitudinal arch.

ASTRAGALUS FRACTURES

Fractures of the astragalus are relatively infrequent, since the bone is protected from injury, and major fractures occur only as the result of great violence. The most serious injury is dislocation of the body, which may occur with or without fracture through the neck.

Inversion and eversion strains of the ankle may cause small chips to be knocked off the superior articular surface of the astragalus which are similar in radiologic appearance to osteochondritis dissecans. These chips should be surgically removed. Forced plantar flexion of the foot may cause avulsion of a small piece of bone from the neck of the astragalus at the capsular attachment. No treatment is required other than fixation in a plaster of paris walking cast for three weeks or adhesive strappings.

The basic fracture of the astragalus is through the neck and is caused by forced dorsiflexion, whereby the neck of the astragalus impinges against the anterior margin of the tibia. Often no displacement is found and no treatment is necessary other than application of a plaster of paris cast from the knee to the toes with the foot in neutral position for six weeks.

Fractures of the neck of the astragalus with only minimal displacement are often associated with a subluxation of the astragalocalcaneal joint. This dislocation can be reduced by traction and strong plantar flexion of the foot. A plaster of paris cast should then be applied with the foot strongly plantar-flexed for approximately six weeks. After this cast is removed, the foot should usually be kept in neutral position in a walking cast for an additional four to six weeks.

Fractures through the neck of the astragalus with complete lateral or posterior subluxation of the body are extremely difficult problems and are as disabling as any fracture of the lower extremity. Such fracture-dislocations are often compound. The end result is bound to be imperfect and one must expect a limitation of some 50% of ankle joint motion, with more or less complete loss of subastragalar motion, and considerable limitation of motion in the astragaloscaphoid joint.

While children may obtain excellent results from astragalectomy, the same cannot be said of adults. Excision of the body of the astragalus should be reserved for cases wherein the compound wound is markedly contaminated and infection almost certain to develop and where there is actual comminution of the body of the astragalus—which is very rare.

While the body of the astragalus will probably undergo aseptic necrosis if replaced, such a complication will almost invariably leave a better

foot and ankle than an astragalectomy. After exact replacement with complete reduction of the fracture, the foot should be placed in a plaster of paris cast in moderate equinus position.

The cast should be changed in six weeks, the second one applied with the foot in a more neutral position. Plaster cast fixation without weight bearing should be continued for at least four months. Partial weight bearing may then be permitted, unless signs of aseptic necrosis of the body of the astragalus are seen. In such cases, weight bearing should be delayed until time has elapsed for revascularization. This may be a year or more, depending on the severity of the necrosis. If weight is transmitted through an incompletely vascularized os calcis, collapse is certain. After removal of the cast, edema must be controlled and active toe and ankle exercises started.

Subastragalar arthrodesis will allow more rapid vascularization and, if conditions at the time of surgery permit, should probably be done.

If the astragalus undergoes aseptic necrosis and collapse of the body occurs, arthrodesis of the ankle, subastragalar and astragaloscaphoid joints may be necessary. This further adds to the total disability, besides delaying recovery about six months.

Dislocations of the body of the astragalus which result from severe inversion strain to the ankle have a prognosis as grave as that of fractures through the neck with dislocation of the body. Treatment is essentially the same. Plaster of paris cast fixation need not be maintained beyond a three-month period in the absence of any signs of aseptic necrosis. However, aseptic necrosis is almost certain to ensue and, if so, plaster cast fixation should be continued without weight bearing for some six months. Weight bearing then should be permitted only when revascularization of the astragalus is shown by roentgenograms.

SCAPHOID FRACTURES

Fractures of the tarsal scaphoid are rare. They result from a compression force when a sudden thrust is taken upon the metatarsal heads with the foot plantar-flexed and partially adducted. This results in a dorsal displacement of the major portion of the scaphoid and occasionally subluxation of the astragaloscaphoid joint with adduction of the forefoot. The displacement may involve the entire scaphoid. Aseptic necrosis is probable.

The fracture is reduced by manipulation with strong traction in eversion and plantar flexion, combined with a downward pressure on the displaced fragment. Often the reduction cannot be maintained, and transfixion of the fracture with a Kirschner wire is necessary. Open reduction is sometimes necessary when the displaced fragment is large. Scaphocuneiform arthrodesis should then be done, using internal fixation with two Kirschner wires.

Unless internal fixation is used, the cast should extend from the knee to the toes with the foot plantar-flexed and abducted. After six weeks the cast may be changed and a more neutral position assumed. If internal fixation is used, the foot should be

put in the neutral position from the start. Weight bearing in a well-fitting cast may be permitted after pain and swelling have moderated.

After three months, roentgenograms usually show adequate healing and cast fixation may be stopped.

METATARSAL FRACTURES

Metatarsal fractures are very common and the prognosis is excellent if the fractures are reduced and held in position until healed. When the fractures are multiple, the displacement great, and the soft tissue injury significant, the residual disability will be considerable and treatment must be most exacting.

Fractures through the distal third of the metatarsals are usually transverse with plantar angulation of the head. They are very disabling if not accurately reduced. Open reduction may be necessary, but usually reduction is obtained by traction and manipulation. A plaster of paris cast is then applied from the knee to the toes, with skeletal or pulp traction to the affected digit attached to a wire outrigger by rubber bands.

The traction is removed in three weeks, and the cast in six. A metatarsal bar is used on the shoe after removal of the cast, and crutches are usually necessary for two weeks.

Fractures of the base and of the shaft of the metatarsals are treated alike if displacement is present. If without displacement, they may be treated by a walking cast for three weeks. A cast must always be used in fractures of the first metatarsal, but in single fractures of other metatarsals without displacement adhesive strapping is permissible.

Fracture of the base of the fifth metatarsal is the most common fracture of the foot. The peroneus brevis inserts into the tuberosity of the base of the fifth metatarsal, and an inversion sprain may result in fracture.

If not displaced, this fracture may be treated by strapping the foot and ankle in eversion and dorsiflexion. If displaced, reduction is accomplished by local pressure. The cast is applied from the knee to the toes, with the foot dorsiflexed and everted and worn for a period of three weeks.

PHALANX FRACTURES

Fractures of the proximal phalanx of the great toe require accurate reduction and fixation in a plaster of paris cast extending from the knee to the ends of the toes, with the foot in midposition and the toe moderately flexed. Muscle pull exerts a strong tendency toward plantar bowing at the fracture site. This will result in a painful callus.

Traction for two to three weeks is necessary if the fracture is unstable or involves a joint. The cast should be left on for three to five weeks. Malunited fractures produce disability by abnormal pressure points leading to painful calluses and by ankylosis of the metatarsophalangeal joint. Either disability warrants corrective surgery.

Fractures of the phalanges of the remaining toes are less prone to disability. Plantar bowing or displacement may lead to painful calluses, and occasionally a cast and even traction may be necessary.

It is generally adequate to strap the

injured toe with adhesive to its intact neighbor for three weeks. Cotton pledgets moistened with alcohol should be placed between the toes to prevent maceration and infection. Fresh strapping should be done every four to six days and the skin well cleansed each time.

Fractures of the mid and distal phalanges may be treated with circular strapping or collodion dressing for two to three weeks. Collodion makes a most satisfactory splint, but shrinks when setting, and caution must be observed to prevent constriction of circulation.

CONVALESCENT TREATMENT

All major fractures of the foot require diligent treatment following reduction if optimum results are to be obtained.

The following principles apply:

Plaster of paris cast

► The cast should extend from knee to toes with the foot in neutral position except as otherwise indicated.

► The cast should be light. Four rolls of ordinary plaster are adequate, and one additional roll used for walking appliance.

► Unless transfixion pins are used, the cast should be changed after the swelling has subsided and new casts applied as often as necessary to keep them snug.

► Padding should be minimum.

Control of edema—The control of swelling following the removal of a cast is extremely important to prevent stiffening of the joints and tendon adhesions, which otherwise will become permanent. Some type of support must be used until all tendency to swell is over. An elastoplast or a Unna paste dressing is excellent after removal of the cast. In less severe cases, an elastic bandage is satisfactory.

Physical therapy—In fractures of the tarsal bones, active toe exercises should be started early and continued. Active exercises of the foot and ankle are essential after removal of the cast. Circumduction exercises with the forefoot rotated in a clockwise and counterclockwise direction are simple and excellent. Heat, massage, and other passive exercises are of little value in comparison with active, repetitive movement.

Shoe corrections

1] Longitudinal arch supports are particularly helpful following fractures of the os calcis and fractures of the scaphoid, and should be worn at least one year.

2] The metatarsal bar is an essential part of the treatment of fractured metatarsals after fixation has been discontinued and the patient has begun walking. The bar should be used for several months.

3] An inside heel tilt of 1/8 to 3/16 in. is often very beneficial in relieving discomfort following fractures of the os calcis and scaphoid and should be worn several months.

4] A total heel raise of 1/4 in. is sometimes helpful following fractures of the os calcis.

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Fractures of the Spine and Pelvis

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Prepared for Modern Medicine

Spinal Fractures

THE two greatest causes of fractures of the vertebral column are automobile and industrial accidents. Fracture is produced by acute flexion of the two ends of the spine, resulting in compression of one or more vertebrae. This is commonly called jackknifing of the spine.

Pathology—The body of the vertebra, made of relatively soft, mushy, cancellous bone, gives way. The body usually breaks on the anterior superior border; rarely is the anterior inferior portion fractured.

The vertebra above conforms to the upper border of the wedging, producing a kyphosis. The anterior spinal ligament is very dense and strong. It becomes relaxed with the narrowing of the anterior margin of the vertebra. For this reason some of the cancellous bone of the fractured vertebra is forced anteriorly and is seen under the relaxed ligament. There is associated hemorrhage and hematoma formation, and, in some cases, retroperitoneal hemorrhages develop with symptoms suggesting peritonitis.

The damage may not be limited to the bony structures. The cord may be injured. Should severance of the cord occur, the damage is irreparable, since the cord does not regenerate.

Symptoms and signs—A person with a fractured spine, especially during the first two or three weeks, always has one characteristic symptom, a point of localized pain or tenderness. Associated with it many times is a deformity, a kyphosis, with or without localized discoloration of the skin and edema over the area. Rigidity of the spine results from the muscle spasm.

Two types of cord injuries occur: those with complete severance, and those resulting from pressure. All fractures of the cervical spine above the fourth cervical vertebra with displacement and severance of the cord cause death within a short time. They produce a paralysis of the diaphragm innervated by the phrenic nerve, the main fibers of which come from the fourth cervical nerve.

Fractures below the fourth vertebra show symptoms of pressure upon different parts of the brachial plexus. If the patient is breathing and has quadriplegia, the severance must be between the fourth and fifth cervical nerves. In the cervical region, a very accurate diagnosis can be made if the origin of the brachial plexus is remembered.

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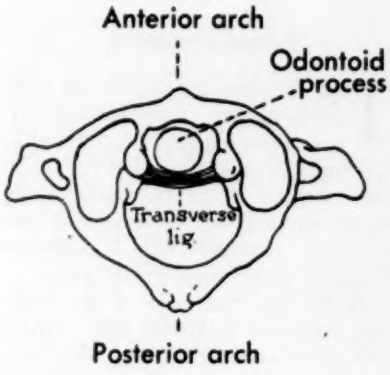
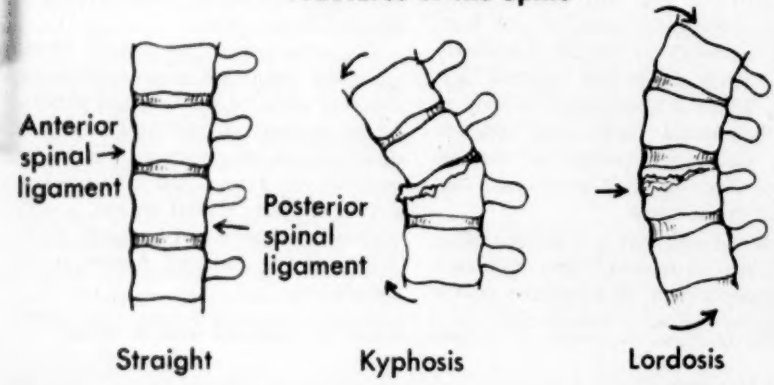
Contours of the Spine



Fractures of the Spine



Below the cervical segment the neurologic diagnosis is quite difficult. The injury is hard to localize. Most fractures occur where the normal lordosis meets the normal kyphosis, at the first lumbar vertebra. If the reflexes are absent immediately after the accident, the cord is probably severed.

Diagnosis—The history is of great importance. The symptoms and signs and the roentgen findings confirm the diagnosis. Roentgenography, however, is not the last word.

In making the diagnosis, other possibilities must be considered, such as injuries to soft tissues. The physician must be able to differentiate pains in the back from renal or biliary calculi, from traumatic tearing of muscles, such as the erector spinae muscles, from acute pancreatitis, or other conditions. Hysterical patients and malingerers are the most difficult subjects to diagnose.

Prognosis—The less one attempts to prognosticate, the less frequent will be the errors. The patient should never be told how long he will be in the hospital or when he can go back to work. It is an art to talk for half an hour in glimmering generalities without saying anything specific!

The mortality from fractures of the spine is less than 3%, considering all types. When death occurs, it is almost always from injury to the spinal cord with subsequent complications.

The period of morbidity depends on the location of the fracture. Patients with fractures of the cervical segment are usually disabled about four to six months. Those with fractures of the thoracic and lumbar segments are incapacitated six to eight months if the condition is uncomplicated.

Complications—Sometimes traumatic arthritis develops in the facets of the spine. In such cases, patients continue to have pain until a spinal fusion is performed. There are also serious ligament and intervertebral disk injuries that do not show on roentgenograms and which frequently leave the patient with a painful back and limitation of back motion. In industrial cases in constitutionally inadequate individuals, a traumatic neurosis is not uncommon.

Treatment—Therapy depends on the location—whether a cervical or thoracolumbar segment is involved.

Fractures of the cervical region must be treated by traction. A halter is applied to the patient's head with usually no more than 5 to 7 lb. of traction. Greater weight is not well tolerated unless tongs are inserted into the skull. The head end of the bed is raised so that the patient's weight pulls him down in bed. The back rest may be elevated to put him in a semisitting position. The head is maintained in hyperextension. Boards may be put under the shoulders to keep the bed from sagging.

Hyperextension is maintained until enough soft callus is formed, about three to four weeks. The patient is then placed in a cast which runs from the occiput and chin to the epigastric region. This is worn eight to ten weeks.

In cases with considerable displacement that cannot be reduced by traction, careful manipulation under anesthesia is recommended. The dangers of producing injury to the cord

and possible death must not be forgotten.

The Watson-Jones method of hyperextension has been used by the author since 1933 for the reduction of fractures of the thoracolumbar segment and for application of a cast. The patient is given morphine, 0.25 gr., and atropine, 1/150 gr., an hour before the reduction. He is then placed face down across two operating tables, one 18 in. higher than the other. Either ethylene, cyclopropane, or nitrous oxide anesthesia is given.

The kyphosis, in most instances, can be reduced by direct pressure of the hand over the fractured segment. A cast is then applied from the jugular notch to the symphysis pubis. The patient is permitted to be ambulatory in forty-eight to seventy-two hours. Usually two to three days are necessary to make the cast comfortable; then, in less than one week, the patient is home feeling quite well.

Ordinarily, the weight on the spinal column is carried in the centers of the vertebral bodies. With hyperextension, the weight is sustained on the posterior portion of the vertebral body.

With only a few exceptions the posterior portion of the body of the vertebra remains intact. One cannot possibly recompress the fractured anterior portion of the vertebra as long as the body weight is carried on the posterior portion of the vertebra.

The patient is allowed to be up and around. The cast is worn from four to nearly five months under ordinary conditions. It is then removed, and physiotherapy is given in the form of heat, massage, and graduated exercises. No spine braces are used after the cast is removed.

Under ordinary conditions, the patient can go back to heavy physical work at the end of six to eight months, providing litigation is not going on. However, with litigation pending, in the author's experience, many patients refuse to go to work until the case is settled for fear that the award may be jeopardized. They get well the day after the check clears the bank!

Treatment of complications—When painful traumatic arthritis of the spine continues and the patient becomes an invalid in spite of every kind of conservative treatment, fusion is performed on the fractured vertebra, plus the vertebra above and the one below the site of the fracture. After four to six months the patient has a rigid back but no pain.

With paralysis or neurologic involvement, the history is very important in determining whether or not operation should be done immediately. The pathology is severance of the cord, if the history goes: "The car turned over, I couldn't remember anything, I was unconscious. Then I couldn't feel or move my feet or legs." The diagnosis is pressure, if the story is: "We turned over. I was unconscious, though not very long, and was able to walk to the curb and sit down. At the hospital I couldn't move my legs. They were numb, and in three hours I couldn't twitch my toes."

In the second case laminectomy should be done. The patient without reflexes immediately after the accident will never regain cord function, so a laminectomy is not indicated. If

reflexes were present on admission and markedly diminished six hours later, pressure is increasing and laminectomy should be performed.

Air myelography or pantopaque studies can give a great deal of information as to the localization of the lesion and extent of the spinal block.

The treatment of a paralyzed bladder is debatable. The patient has no control of micturition; the urine distends the bladder and then begins to dribble. The patient decompresses himself, but each time the pressure gets higher. The urine pressure increases in the ureters, and dams back in the renal pelvis; hydronephrosis results.

Finally there is destruction of the kidney, with just a thin cortical layer left. The musculature of the bladder gives way with a resulting diverticulitis. Retention and decomposition of urine in the bladder lead to calcium deposits along the bladder wall.

Infection occurs in all these cases. If the patient is catheterized three times a day, he gets an infection quicker. The urethra cannot stand having the catheter put in or left in for long periods of time. For this reason a suprapubic cystotomy is the best solution to this problem.

Relatively few persons with bladder involvement as a result of paralysis live beyond twelve to eighteen months, unless they receive constant, competent care. As a result of the experience gained in World War II with tidal drainage, genitourinary, neurosurgical, orthopedic, and plastic surgical care, many paraplegics have done much better, felt better, and lived longer than was possible heretofore. The usual cause of death for these patients is an ascending pyelonephritis.

Pelvic Fractures

Considerable force, usually of compression, is required to break the pelvis. The amount of pathology depends on the force. No one ever died of a fractured pelvis, but many have died of the associated pathology.

Pathology—Fractures of the wing of the ilium usually do not have much displacement. Occasionally, when the anterior superior iliac spine is fractured, the muscle pulls it out of position. Violence on the trochanteric region produces acetabular fracture or central dislocation of the hip.

The most common type of fracture is of the superior and inferior rami of the pubis. Such injuries usually occur without much displacement. Sometimes the whole side of the pelvis is shifted up because of a fracture involving the wing of the ilium and the superior and inferior rami of the pubis. For this reason one leg appears shorter than the other.

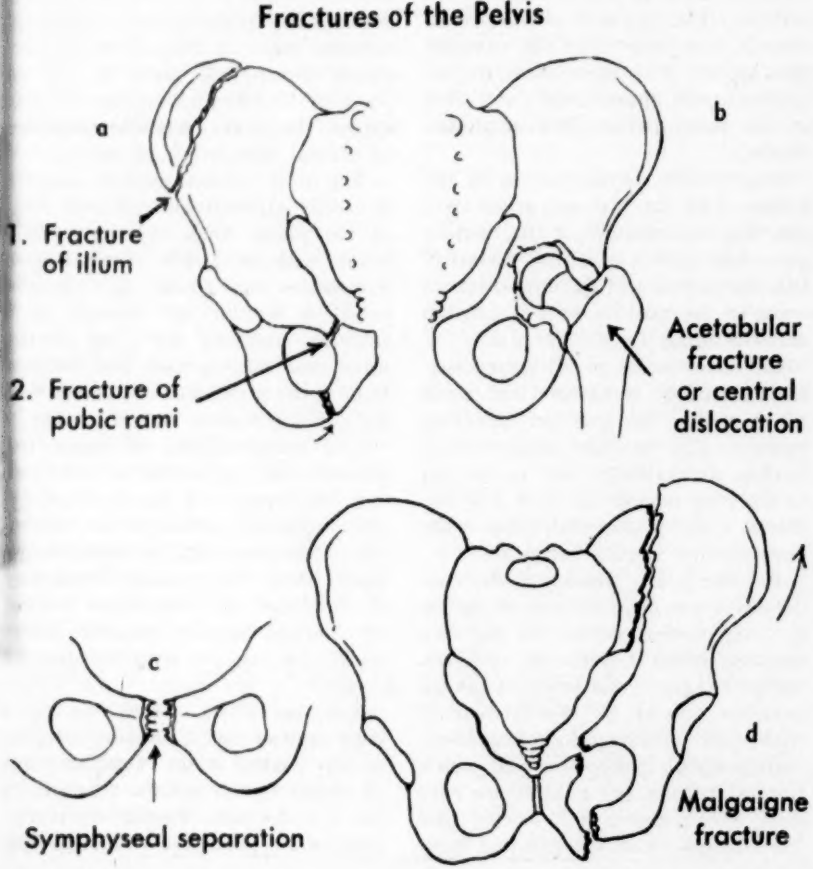
The complications of major importance are [1] rupture of the bladder, [2] rupture of the urethra, [3] perforation of the bowel, an uncommon occurrence, and [4] hemorrhage. With severe hemorrhage from one of the large intraabdominal vessels, the patient usually expires before much aid can be rendered by the doctor.

Symptoms—The pelvis forms a bony cage so that if pressure is borne on any part of it, an exquisite point of tenderness is always referred to the fracture site. People with fractures of the pelvis are unable to bear

much weight on the leg. They may be able to hobble, but not without much pain. Most of them have a localized hematoma and edema over the area of injury. Usually there is ecchymosis in the perineum with fractures of the pubis or ischium. Deformities are difficult to detect by clinical methods, but will be shown by roentgenograms.

Fracture of the wing of the ilium gives a peculiar distortion of the hip contours. Fractures of the pubis are hard to detect clinically except for the localized point of tenderness. A central dislocation of the hip is easy to spot if the pelvis is exposed, as one notices that the normal fullness of the hip is missing. The distance from the symphysis pubis to the greater trochanter is less on the injured than on the uninjured side.

In cases with separation of the symphysis pubis, the separation can



be palpated between the two sides, if the patient is not obese. The separation is more easily felt in males than in females.

Diagnosis—The diagnosis is based on the history of compression force, the symptoms and signs, and the roentgen findings.

In fractures of the pelvis, the important consideration is diagnosis of the complications, of which rupture of the urinary bladder is perhaps the commonest serious one. Catheterization is most important. Blood in the urine is very suggestive.

If no specimen can be obtained, a measured amount of sterile saline solution, 200 to 300 cc., is injected into the bladder. If the same volume is recovered, the possibilities of a ruptured bladder are remote. If some of the saline cannot be recovered, it is fair to assume that a rupture of the bladder exists and that seepage has occurred into either the extra- or intraperitoneal areas. The urine extravasates into the abdominal wall and causes necrosis and sloughing.

If the tear is small, decompression of the bladder may be all that is necessary. With a large tear, operation is necessary; the rent is sewn completely and decompression of the bladder maintained. A suprapubic cystotomy is preferable to keeping a catheter in the urethra for a long time because ulceration and stricture formation are apt to occur.

Rupture of the urethra is relatively uncommon and appears only in males. A catheter cannot be passed beyond the rupture, because the continuity is broken and the catheter sticks in the periurethral tissue. Restoration of the continuity of the urethra is imperative. This repair should never be done by the occasional operator; the assistance of a genitourinary surgeon is indispensable.

Bowel perforation is frequently confused with retroperitoneal hemorrhage. With the latter, many of the symptoms of peritonitis are present, including a rigid abdomen. However, careful blood counts and hematocrit studies repeated every two hours, showing a decrease in hemoglobin or red blood cell count, will aid in the diagnosis.

In case of doubt, it is better to do an exploratory laparotomy than to overlook a perforation of the intestine. With perforation, some air usually leaks into the peritoneal cavity and can be isolated between the dome of the liver and the diaphragm by roentgen studies. The presence of the gas bubble on the roentgenogram is conclusive of a perforated bowel.

For retroperitoneal hemorrhage, the cardinal principles of therapy are blood replacement, supportive treatment, and no surgery.

Treatment—The average case of fracture of the pelvis requires a certain amount of common sense in therapy. If the symptoms indicate fractures of both rami of the pubis in excellent position, bed rest and supportive treatment are all that is necessary.

Fractures of the wing of the ilium with marked displacement, especially of the anterior superior spine, should in rare instances be opened and surgically re-placed.

In fractures of the acetabulum with inward dislocation, the treatment is 15 lb. of longitudinal traction and, in addition, lateral traction. This is

best obtained by insertion of a long screw into the neck of the femur for 2 or more inches and the use of 10 lb. of lateral traction. The lateral screw traction is left in three weeks, and the longitudinal traction six weeks. The callus will not be firm enough in six weeks for weight bearing. It will take twelve to fourteen weeks before the patient can walk with crutches, bearing some weight on the extremity. Full weight bearing is usually not permitted in less than four to five months.

With a Malgaigne fracture, the whole side of the pelvis may be pulled up about ½ to 1 in. Longitudinal Buck's extension with traction of 15 to 20 lb. on the affected side helps to correct the displacement. When reduction cannot be achieved by traction within seventy-two hours, the author favors putting the patient to sleep in bed, pulling down the displaced side, and reapplying traction.

Separation of the symphysis pubis, if slight, requires lateral pressure. This is best obtained by a pelvic sling which keeps the bone ends together twenty-four hours a day. The sling never slips or loosens. Adhesive does little good; if applied snugly enough to be of any value, it produces pressure sores and, if applied loosely, is worthless. This separation is a ligament tear and must be treated at least eight weeks.

Occasionally, with terrific violence, the symphysis pubis is widely separated. In this case some form of internal fixation must be applied, such as the Parham-Martin band, that holds the two sides of the symphysis pubis in apposition.

Isolated fractures of the sacrum are rare and occur only from direct violence to the sacrum alone. Treatment consists of bed rest. With marked comminution, the injury to the remainder of the body is so severe that the fracture assumes a secondary role.

In many years of active practice, the author has never felt that the application of a cast for a fractured pelvis was indicated. Traction, pelvic slings, and split mattresses meet any possible requirements and are certainly more comfortable for the patient and more efficient as treatment and permit better nursing care.

COLLES' FRACTURE may sometimes cause a subcutaneous rupture of the extensor pollicis longus tendon. This complication is easily recognizable because of the droop of the thumb and the impossibility of extending the distal phalanx. Edwin David Weinberg, M.D., of Johns Hopkins University, Baltimore, finds that the results of prompt surgical treatment are usually satisfactory. When degenerative changes, retraction of the tendon, or excessive adhesions make end-to-end suture impossible, various forms of tenoplasty may be used. Grafts of dead ox fascia have been used satisfactorily.

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Fractures in Children

WALTER P. BLOUNT, M.D.*
Children's Hospital, Milwaukee

Prepared for Modern Medicine

FRACTURES in children are different from similar fractures in adults. This is because children grow after fractures have healed.

Continued growth is important for three reasons. First, an increased rate of growth due to the increased blood supply will tend to equalize shortness from overriding. Second, growth will correct minor angular deformities near the ends of bones. Third and adversely, if growth is retarded following the injury of an epiphysis, deformity and shortening may result.

Common fractures in children follow more regular patterns than those in adults. The results of good treatment are routinely better but, with improper care, the complications may be disastrous.

The principles of treatment are simple. Alignment is the chief requirement in children. The fracture should not be angulated or rotated. Apposition and length are of little significance. In most cases, excellent results are obtained by simple traction or closed reduction and a cast.

The exceptions which require open reduction are definite and predictable. They comprise three relatively common fractures about the elbow and a few rare articular fractures elsewhere. Except in these fractures, open reductions in children are difficult to justify.

FRACTURES OF FEMUR

Femur fractures are still mistreated. There are competent surgeons who feel that open reduction is justifiable. We have collected some horrible results of casually performed operations for plate fixation. These tragic complications include: sepsis and death, chronic osteomyelitis, deformity with joint stiffness, repeated refracture, and persistent nonunion.

On the other hand, treatment by traction or cast has given uniformly good results without any complications. End-to-end apposition is not only unnecessary but undesirable. In a large series of cases, the average overgrowth was 1 cm. A start with 1 cm. of overriding means a finish with more nearly equal leg length. Side-to-side union is more rapid and stronger than end-to-end.

Fractures of the shaft are uniformly well treated with double Bryant overhead traction (Fig. 1) in young children, and Russell traction (Fig. 2) in older children. Proper adjustment of two sets of weights and pulleys will align any fracture. Adduction of the proximal fragment is relieved by increasing traction on

* Chairman, Fracture Service, Milwaukee Children's Hospital; Staff, Columbia Hospital, Milwaukee; Consultant, Staff of Milwaukee County Hospital, Wauwatosa, Wis.

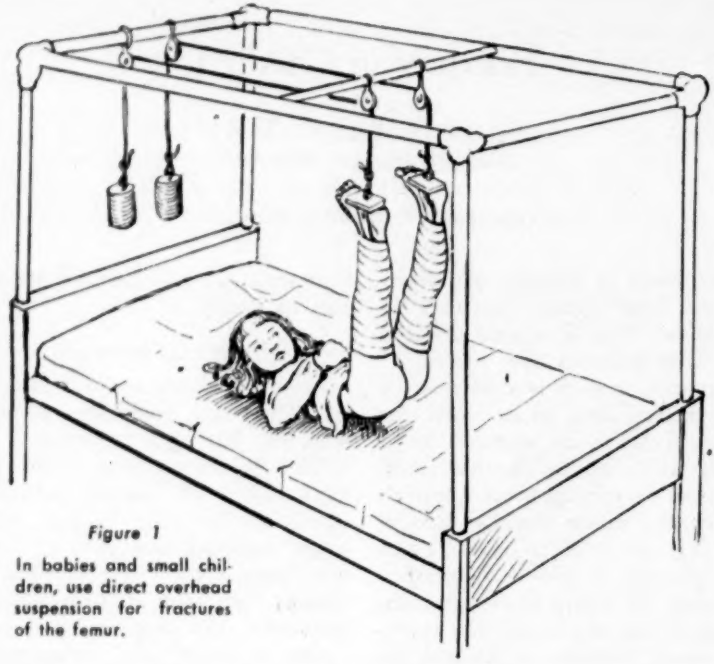


Figure 1

In babies and small children, use direct overhead suspension for fractures of the femur.

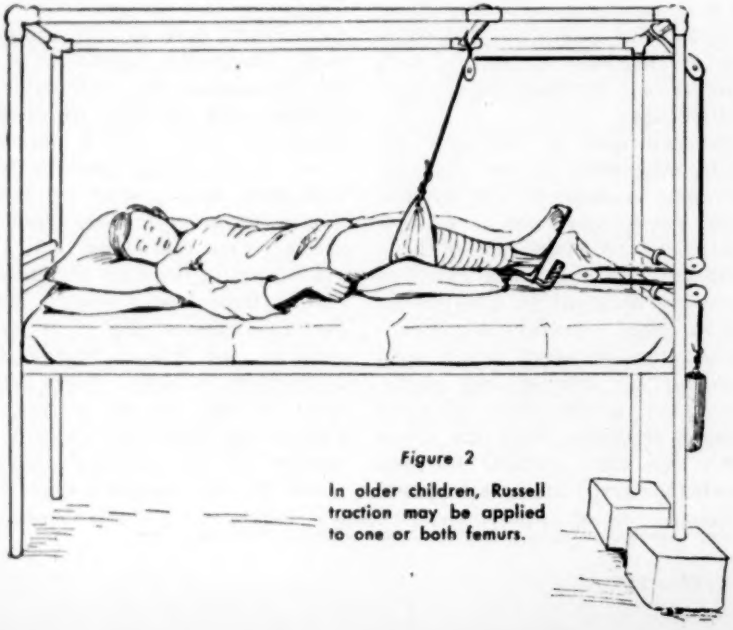


Figure 2

In older children, Russell traction may be applied to one or both femurs.

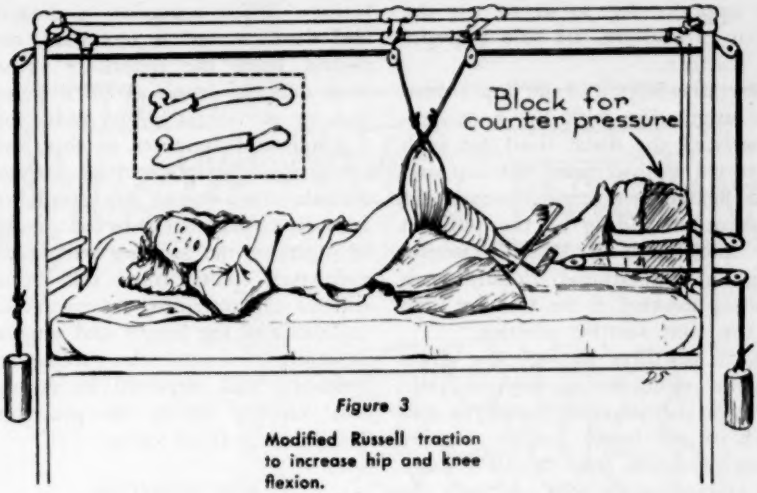
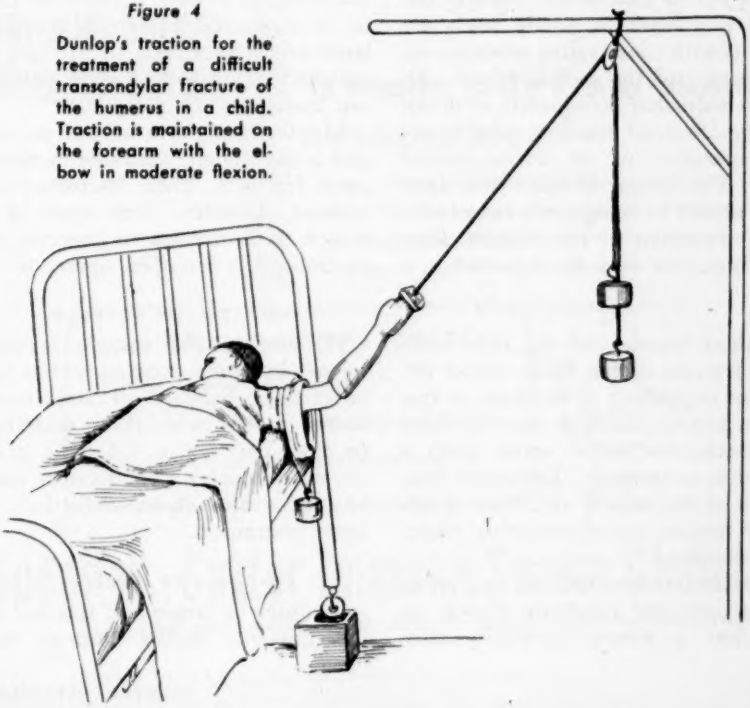


Figure 3

Modified Russell traction to increase hip and knee flexion.

Figure 4

Dunlop's traction for the treatment of a difficult transcondylar fracture of the humerus in a child. Traction is maintained on the forearm with the elbow in moderate flexion.



the opposite leg so as to tilt the pelvis caudad on the side opposite the fracture.

Excessive flexion of the upper third and angulation with the apex posteriorly of the distal third are both corrected by increasing the hip and knee flexion by changing to overhead traction or adding to the pull on the knee sling of Russell traction (Fig. 3). Rotational deformity is easily prevented if the feet are kept in the same relative position.

Rare fractures through the distal femoral epiphysis occasionally, and through the proximal epiphysis and neck of the femur usually, require open reduction. The first is a surgical emergency because of likely circulatory embarrassment.

Except as mentioned, open operation is difficult to justify when the results with conservative measures are so good and the complications with open reduction occasionally so devastating. Skeletal traction should not be necessary in an uncomplicated case. The danger of epiphyseal damage should be recognized. In general, cast treatment is less reliable than traction, but may be indicated.

TIBIAL FRACTURES

Spiral fractures of the tibia without fracture of the fibula are of frequent occurrence in children. A cast from toes to midthigh with the knee in flexion for five to seven weeks is all that is necessary. Transverse fractures of the middle and distal thirds may require closed reduction under anesthesia.

Ankle fractures are rare and usually involve the epiphysis. Closed reduction is almost invariably satisfactory. When reduction is delayed and displacement is moderate, one should leave the deformity rather than add the insult of open reduction or of violent closed reduction.

Epiphyseal fractures at this level are frequently followed by arrested growth. The degree of retardation is in direct proportion to the amount of injury to the growing cells of the epiphyseal plate from the initial trauma or subsequent treatment. Inequalities of leg length and angular deformities should be recognized promptly and corrected by epiphyseal stapling[1] before the procedure is too late to be of value.

FOOT FRACTURES

Fractures of the foot are usually due to direct trauma. A displaced tarsal or metatarsal fracture is manipulated under anesthesia to produce a normal looking foot. A short plaster cast maintains the position.

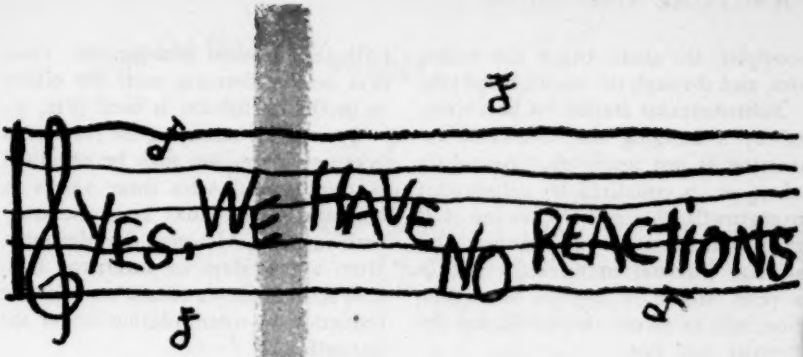
Supplementary skin traction on the toes is occasionally desirable in metatarsal fractures. These fractures heal without disability even when displaced. It is difficult to conceive of an indication for open operation.

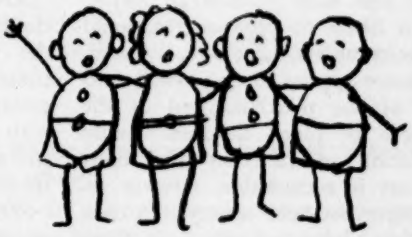
FRACTURES OF CLAVICLE

Fracture of the clavicle is well treated in young children with a figure-of-eight bandage of stockinette stuffed loosely with sheet wadding. In older children, a Billington plaster yoke or other rigid fixation may be preferable. Open reduction is never warranted.

FRACTURES OF HUMERUS

In order of frequency, fracture of the humerus occurs through the





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condyles, the shaft, below the tubercles, and through the upper epiphysis.

Subtubercular fracture is best treated by a hanging cast. Accurate reduction is not necessary. Overriding of ½ in. is equalized by subsequent overgrowth. Bayonet apposition will give immediate perfect function and normal internal architecture within a year. Moderate degrees of angulation will be overcome, rotational deformity will not.

Bed rest with traction in abduction is likely to produce rotational deformity unless the elbow is flexed. The same applies to epiphyseal fractures of the proximal end of the humerus in older children. Rapid restoration of function and bony contours is remarkable. Growth arrests have not been observed A common but vicious mistake is to think that open reduction is justified. Operation causes limited motion.

Supracondylar fractures of the humerus are usually produced by hyperextension at the elbow with a fall on the outstretched hand. A greenstick fracture is angulated with the apex anteriorly. In a complete fracture with posterior and proximal displacement of the distal fragment, the deformity is extreme and the roentgen appearance alarming to the uninitiated.

If the fracture is treated promptly and soft tissue damage is slight, immediate closed reduction and fixation in moderate flexion produce a high percentage of excellent results.[2] Accurate reduction lessens the likelihood of vascular embarrassment.

If soft tissue damage has been severe or reduction delayed, swelling may be extreme. Attempted closed reduction is then undesirable. Traction on the forearm with the elbow in moderate flexion is used (Fig. 4).

By careful balancing of forces, an excellent reduction may be obtained in most cases.[3] After three weeks in bed, the patient may be ambulatory with a sling. It may be desirable after a few days to interrupt traction in bed and to obtain an accurate reduction by manipulation under anesthesia.

Results with open reductions in children are worse than those with the slower, more time-consuming, conservative measures. Comminuted condylar fractures can be reduced with surprising accuracy if seen promptly. They may be maintained in position by a hanging cast.

The most dangerous complication of all elbow and forearm fractures and, in particular, supracondylar fractures is Volkmann's ischemia.

The warning signals are pain in the fingers, pallor or blueness, coldness, swelling, and loss of motion and sensation. With the appearance of any of these signs or symptoms, external fixation in flexion should be released. Immediate suspension and elevation by nonconstricting traction on the forearm are indicated. Icebags should be applied to the elbow and forearm. Prompt blocking of the appropriate sympathetic ganglia is frequently effective.

If the symptoms are well advanced or will not subside with conservative treatment, no time should be lost before exploring the cubital fossa and volar aspect of the forearm. The tough fascia is slit, permitting the explosive extrusion of edematous muscles. An injured or severely con-

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stricted brachial artery should be resected. This maneuver relieves vasospasm and reflex involvement of intimate vasculature of the muscles.

Delay is disastrous. Within three or four hours, irreversible changes have occurred. A claw hand usually means inadequate or delayed therapy.

ELBOW FRACTURES

Fractures of the lateral condyle are not fully appreciated. The immediate local symptoms are less arresting than with supracondylar fractures. Function is surprisingly good. The injury is frequently dismissed as a sprain.

Most of the distal end of the humerus is still cartilaginous, so that the characteristic displacement of the capitellar fragment remains unrecognized in the roentgenogram. This condyle is usually angulated distally through 180° and rotated 90° by the attached extensor muscles of the forearm. Even if promptly reduced by closed methods, the fragment is often displaced again by these muscles.

When unreduced, this fracture usually fails to unite. The articular cartilage is opposed to the raw fractured surface of the shaft. The immediate disability is insignificant. Gradually the carrying angle of the elbow increases.

Radial deviation of the hand occurs. Deformity, weakness, and pain in the elbow follow. The most significant disability is delayed ulnar nerve palsy, which comes on about twenty years after the injury.

Closed reduction with fixation in flexion must be proved successful by frequent roentgenograms. Open reduction and internal fixation are usually necessary. The results following prompt operation are ordinarily excellent.

Avulsion of the medial epicondyle results from valgus strain of the elbow with or without dislocation. If the displacement is slight, immobilization in flexion for three weeks is all that is necessary.

If the displacement is greater than 5 mm., open reduction must be considered. Closed reduction is of no value. If the fracture remains untreated, it usually fails to unite. Nonunion confers little disability and may be the desirable end result in girls.

Considerable displacement makes for weakness and loss of contour. Prompt open reduction with replacement of the fragment and fixation with a removable metal pin are desirable. If dislocation has occurred and the fragment of the medial epicondyle is incarcerated in the elbow joint, operation is imperative. In fresh cases, the medial epicondyle is replaced. If the operation is delayed, it may be preferable to excise the fragment and suture the aponeurosis of the flexor muscles to the medial condyle.

RADIAL NECK FRACTURES

Fractures of the radial neck illustrate well the difference between fractures in children and adults. Angulation or displacement toward the radial side is characteristic. Angulation of 45° is of little real significance.

Manipulation is not necessary but may improve the position. Immobilization in a cast with the elbow at right angles promotes rapid healing.

(Continued on page 118)

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Capsules and tablets in half the above potency available for children and mild cases in adults.

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Bacitracin Ointment-C.S.C. contains 500 units of bacitracin per gram. It has produced excellent results in the treatment of ecthyma, infectious eczematoid dermatitis, folliculitis, sycosis vulgaris, and pyoderma gangrenosum. In decubitus ulcer it not only controls the infection promptly but also encourages more rapid healing. Impetigo contagiosa responds particularly well, many cases completely clearing up within 48 hours of the initiation of therapy.

*Derzavis, J. L.; Rice, J. S., and Leland, L. S.: Topical Bacitracin Therapy of Pyogenic Dermatoses; a Clinical Report, J.A.M.A. *141*:191 (Sept. 17) 1949.

C.S.C. Pharmaceuticals

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Temporary limitation of all motions at the elbow will gradually subside and roentgenograms will show accurate restitution to normal within a year.

The problem is more serious if the angulation is 90° so that the fractured surface comes to lie against the shaft of the radius. Closed reduction is rarely possible. Persistent displacement causes prolonged disability.

Uninformed surgeons have removed the radial head to obtain motion.[4] The loss of the growth center causes radial deviation of the hand, shortening of the forearm, increase in the carrying angle of the elbow, and weakness. Never remove the radial head in a growing child.

When the displacement is considerable, open reduction and accurate replacement are desirable. No internal fixation is necessary. The radial head may be pulled gently into position with sharp hooks. When reduction is accurate and the elbow flexed, pronation and supination will not dislodge the fragment. Immobilization in flexion should be continued for three weeks.

Olecranon fractures rarely occur as isolated injuries in children. Fixation in extension is permissible. Not infrequently, olecranon fractures are associated with dislocation of the radial head. If both are treated promptly, closed reduction is usually successful. Open reduction of a dislocated radial head is justified if necessary.

Fractures of the proximal third of the ulna associated with dislocation of the radial head (Monteggia) are rare in children and do not uniformly require open reduction as in adults. When the radial head is reduced, the ulna is satisfactorily splinted. Open reduction of the radial head may be necessary.

FOREARM FRACTURES

Fractures of the forearm occur in order of frequency in the distal third, middle third, and proximal third. Open operation is never justified. Greenstick fractures of the distal third may be left unreduced if the angulation is less than 30°. The angulation will gradually disappear.

Angulation of fractures of the middle third will not straighten out entirely except in very young children. Pronation and supination will be limited. Greenstick fractures at this level should be broken completely through. They will then remain in good position in a plaster cast placed from knuckles to midarm, with the elbow at right angles and the forearm in midsupination.

If a greenstick fracture is not broken through, the deformity will return in the cast. Angulation of the cast or the use of pressure pads invites Volkmann's ischemia. No force should be necessary in maintaining the reduction of a forearm fracture. Pain is a warning signal.

Displaced fractures of the proximal third can occasionally be reduced in supination and held in plaster. Overriding is not objectionable. Alignment can be maintained by traction on the fingers with a banjo attachment on the cast. Perfect restoration of the contours will be obtained in a few months. Function will be normal.

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third, except that the forearm should be immobilized in midsupination. Slight shortening is not significant but angulation is not permissible. Malposition is an indication for more efficient conservative treatment and not for open reduction.

A complete fracture of both bones at the distal end of the forearm is usually angulated with the apex volarward with dorsal displacement of the distal fragments. This angulation has a strong tendency to return. It is reduced and immobilized in a long cast in midposition. Checkup roentgenograms after one or two days and again in a week are imperative. An angulation recurrence of less than 25° may be ignored. Eventual function and appearance will be normal.

Progressive increase in deformity in the plaster cast is not infrequent. If the angulation is excessive, another reduction should be performed after the formation of some callus. Careful molding of an unpadded cast will do much to maintain the position. Pressure pads or interosseous rods are to be avoided. Bayonet apposition is satisfactory. Alignment can always be maintained by traction.

Open reduction is not justified. Disastrous complications are rare but are inexcusable when the results with closed methods are so good.

Dislocations and fractures of the carpus are rare in children. Open reduction may be required. The results are surprisingly good.

Fractures of the metacarpals and phalanges should be accurately aligned. Apposition is not important. Fracture dislocations of the digits should be opened to remove capsular obstruction if they cannot be reduced closed.

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How wrong the patient is who shrugs off "a few pounds" of overweight as something of little consequence!
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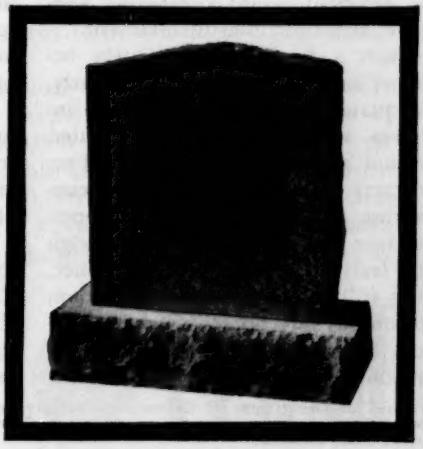

*T.M. Reg. U.S. Pat. Off. for dextro-amphetamine sulfate, S.K.F.

Treatment of Compound Fractures

JAMES E. M. THOMSON, M.D.*
Veterans Hospital, Lincoln, Neb.

Prepared for Modern Medicine

THE fundamental principles for the treatment of compound or open fractures have been long established. Recent experiences with such fractures during World War II in no way changed these principles, but rather amplified them. Fortunately, with the advent of antibiotics and chemotherapy, primary and delayed closure have often made it possible to attain the purposes of treatment much sooner than before.

The aim of any program of fracture treatment is to accomplish union of the fragments in good position and with good function. However, in compound fractures, potential infection always enters as a complicating factor; therefore efforts must first be directed toward preventing pyogenic and clostridial involvement.

Such a fracture immediately becomes an emergency, deserving early, adequate attention. The program involves converting a contaminated wound into a clean, closed wound or, to carry the idea a step further, converting a potentially infected, open fracture into a closed one. Although the fracture is of major importance, it is still secondary to the infection, as long as infection is a possible factor. The adequacy of the emergency treatment depends on whether the infection is eliminated or controlled, so that early healing of the fracture is hastened.

FIRST AID

Perhaps the first thing to do for a compound fracture in order of importance is to cover the wound carefully with a sterile dressing or, if none is available, at least with a clean cloth.

Then, splint the extremity for transportation—"splint 'em where they lie." For the lower extremity, the Thomas splint has no equal. For the upper extremity, the Murray-Jones may be used, or a well-padded board splint if the fracture is below the elbow. The stability and immobilization offered by traction splints contribute greatly to the well-being of the patient and help to prevent shock.

Every fracture is accompanied by some degree of shock, but compound fractures are usually the most severe and the most likely to show evidence of shock.

Shock may be due to hemorrhage, loss of fluids, and a negative water balance. Crushing injuries with traumatized muscle, local anoxia, and interference with circulation cause autolysates to form rapidly in the tis-

* Chief of Department of Orthopaedic Surgery and Consultant, Veterans Hospital; Chief of Department of Orthopaedic Surgery, Lincoln General Hospital; Orthopaedic Consultant, Nebraska State Hospital.

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sues and contribute to shock. Fear, anguish, pain, and exposure all tend to precipitate the symptoms.

Unfortunately, many severely injured patients do not manifest grave shock signs at first and symptoms do not become desperate until, without adequate physical appraisal or proper preparation, untimely operative procedures are attempted. Therefore, from the time of the accident, every precaution should be taken to prevent shock or, if the patient is in a state of shock, to institute appropriate treatment.

The question is often asked: When should shock treatment or shock prevention treatment start? At the site of the accident, in the ambulance, or after the patient reaches the hospital?

The first treatment should consist of protecting the patient from exposure right where the accident occurred. Give morphine for pain. With splinting, the patient can be moved to a near hospital where shock therapy can be continued.

Should circumstances require a long trip to a hospital and the severity of the injury suggest the possibility of shock complication, plasma should be given the patient before or during transportation.

Even when massive hemorrhage has occurred, the plasma loss is felt more than the loss of the formed elements of the blood. Therefore, plasma replacement is immediately indicated. Later, at the hospital, whole blood can be given. When neither plasma nor blood is available, 10% glucose in saline may be used.

At the hospital, roentgenograms should be made immediately and, if the patient's condition warrants, he should be taken to the operating room or shock treatment room and prepared for operation. The time elapsing between injury and cleanup bears directly upon the extent of surgery required to clean up the wound and also upon the possibility of success.

Every minute counts. During the first hours after injury the surgeon has his best chance to remove all infected material. When early, adequate doses of antibiotics and chemotherapy are given, the time lapse before cleanup may be from eight to twelve hours, but the chances of infection are much greater after that, no matter how thorough the debridement.

Tetanus antitoxin should be given at once, unless contraindicated. Persons who have served with the armed forces have been immunized with tetanus toxoid and should be given a 1-cc. booster dose of the toxoid.

DEBRIDEMENT

Unfortunately, some surgeons rely too much on antibiotic therapy; actually, the surgical cleanup of the wound is of far greater importance. Cleanup starts when the patient enters the operating room and not after the surgeon is scrubbed, gowned, gloved and the patient draped.

Our order of procedure is as follows:

1] While traction is maintained, the clothing is cut away.

2] The wound is protected with sterile dressing.

3] Tourniquet is applied for bleeding. We prefer the air-inflated tour-

(Continued on page 128)

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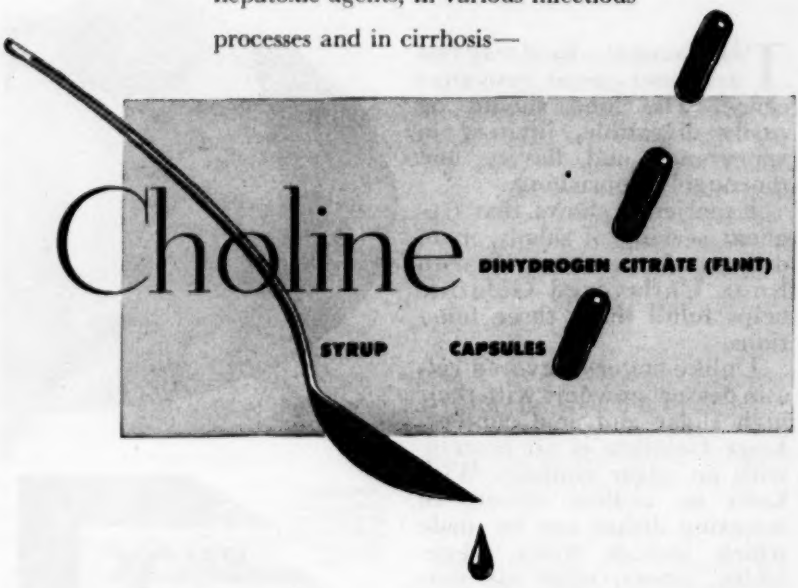

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Sodium Gentisate: A New Approach to the Treatment of Arthritis

It has been estimated[1] that nearly 7,000,000 people (at least one in every 20 persons) in the United States have some form of "rheumatic" disease. Rheumatism (with arthritis the most important single cause) ranks first in prevalence among diseases, and second in the production of disability and invalidism. It is more common than the total number of cases of tuberculosis, diabetes, cancer and heart disease combined.

The most common of the severe forms of the arthritides is rheumatoid arthritis. Although its etiology still remains uncertain, there are factors upon which there is general agreement.[2] (1) Rheumatoid arthritis has a definite tendency to be familial. (2) Eighty per cent of the cases occur between the ages of twenty and fifty with the peak at thirty-five to forty. (3) Females are more commonly affected than males in a ratio of 3:1. (4) Investigation shows that in the period preceding the onset of symptoms, emotional shocks are very common and this is frequently manifested by a severe depression.[3] (5) Pregnancy causes an amelioration of symptoms in a significantly high proportion.[4] (6) Involvement of the liver, as in infectious hepatitis, causes a definite remission in a significant number of patients.[5]

Since Klinge's[6] original work in 1929, evidence has been accumulating that both rheumatic fever and rheumatoid arthritis are diseases of the interfibrillar substance of the connective tissue.[7] The nature of this material is not well understood, although it is presumably a mucopolysaccharide in combination with a protein. This theory holds that changes in the cellular components are secondary to changes in the interfibrillar material. The composition of two of the mucopolysaccharides found in interfibrillar material is known: (a) chondroitin sulfuric acid, and (b) hyaluronic acid.[8] Changes in chondroitin sulfuric acid have been studied in hyaline cartilage which is affected to a considerable degree in rheumatoid arthritis.[9]

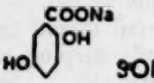
These changes have been on a purely morphological basis[9] and consist chiefly of destruction of hyaline cartilage, presumably due to interference with its blood supply by the overgrowth of pannus and granulation tissue, both beneath the subchondral plate and on the surface of the joint.

On the other hand, changes in the hyaluronic acid of the joint fluid have been shown to be present in active rheumatoid arthritis.[10,11] These changes in active disease consist of depolymerization of the hyaluronic acid and an increase in the total amount of hyaluronic acid present. The excessive presence of hyaluronidase, moreover, has been acknowledged to produce a denaturization of mucin in the synovial fluid, the varying degrees of which are valuable for their diagnostic as well as prognostic indications.[12] Clinicians[13] have concluded that the increase of hyaluronidase activity may be responsible for the breakdown of interfibrillar cement.

A rational approach to the problem, therefore, demands a therapeutic agent that will act to inhibit the spreading effect of hyaluronidase.

Meyer and Ragan[14] treated patients having rheumatoid arthritis and acute rheumatic fever with sodium gentisate, a hyaluronidase inhibitor. Their results were uniform and notably favorable. Within a few days there followed a disappearance of pain, swelling and joint inflammation.

The increase in urinary glucuronic acid observed with salicylates does not occur with gentisates. This phenomenon has been assigned to the rapid oxidation of the gentisates.[15] It is indeed likely, as shown by examination of the structural formulas of these two compounds, that the antirheumatic action of the salicylate in forestalling the spread of hyaluronidase[16] is attributed to its partial oxidation in the body to a gentisate.



SODIUM GENTISATE

The corrective action of sodium gentisate is generally not an immediate one; therefore, as an added therapeutic measure, a salicylate, which provides prompt relief from pain, should be included in the formula.

The product of choice, therefore, should be GENTARTH Tablets, prepared by the Raymer Pharmacal Company of Philadelphia.

Each salol-coated GENTARTH Tablet contains:

Sodium Gentisate	100 mg.
Raysal-Succinate	325 mg.
(representing 43% Salicylic Acid and 3% Iodine in a Calcium-Sodium Phosphate Buffer Salt Combination)	
Succinic Acid	130 mg.

The recommended dosage is two or more tablets three or four times daily (after meals and before bedtime).

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niquet because the pressure can be released or increased at will and we know just how much pressure is needed to stop hemorrhage.

4] With wound and fragments protected by sterile dressing, the surrounding skin is shaved and cleansed with green soap. This is done by sterile handlers with sterile brushes and irrigation of warm distilled water for ten minutes. Soap and antiseptics are kept away from the wound.

5] If possible, traction should be maintained while sterile draping of the extremity is applied.

6] When the surgeon and assistants are sterile, 0.5 cm. of the skin margin of the wound is excised with scalpel.

7] The wound is extended far enough longitudinally for thorough inspection of soft tissue damage and is protected from skin with towels.

8] Warm, sterile saline irrigation of the wound is continued during the debridement, which should remove en masse the dead, traumatized, contaminated soft tissue. Black, dark areas of muscles should be excised down to fresh bleeding surface. Loose fragments of bone, blood clots, and debris must be removed. Soiled bone end fragments are carefully cut away. During this process, continuous saline irrigation is washing away debris and blood clots. The saline should not be forced into deep fascial planes but should be allowed to gravitate out of the wound.

9] Frequent changes of linen, gloves, and instruments may be necessary.

10] Nerves and tendons, which are often very difficult to locate when they retract, should be preserved and reunited in a simple manner after debridement.

The question of whether to attempt primary closure can be answered only on the basis of long experience and judgment. However, primary closure may be considered after good surgical debridement with a fair chance of getting skin healing if:

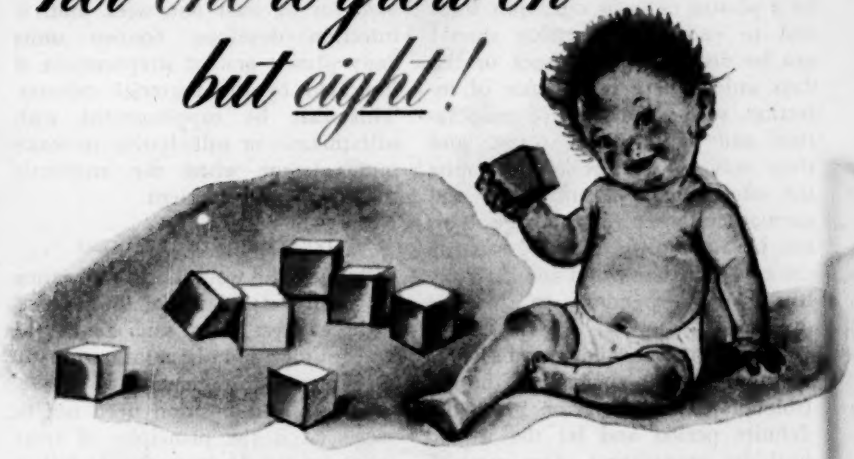
- The soft tissue damage is not severe.
- Contamination of the wound has been alleviated.
- The time elapsed between accident and cleanup has not been long.
- Antibiotics and chemotherapy are started early.
- Circulation of the extremity is uninjured.
- The skin can be brought together without tension.

On the other hand, one should never attempt primary closure if:

- The wound is very extensive, dirty, and difficult to debride.
- Extensive bone and soft tissue damage is found.
- Debridement has been delayed for more than eight to twelve hours after the accident.
- Antibiotics or chemotherapy was not started early.
- The circulation is embarrassed.
- The skin cannot be brought together and closed without tension. Tension further hampers the circulation and increases probability of infection.

When these difficulties are encountered, the wound should be immobilized by a covering of loosely packed, nonadherent, sterile petroleum jelly gauze and a mild pressure dressing of machinists' waste held in place

not "one to grow on"
but eight!



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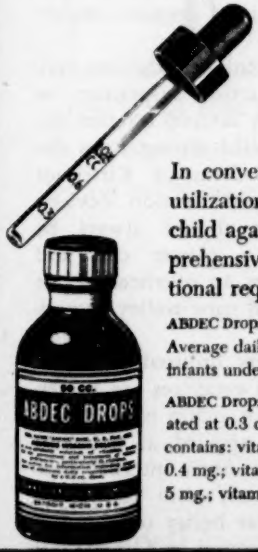

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In convenient liquid form that facilitates rapid absorption and utilization, ABDEC Drops protect the healthy infant and growing child against vitamin deficiencies and afford the sick child comprehensive multivitamin therapy to meet his extraordinary nutritional requirements.

ABDEC Drops may be placed directly on the tongue or added to food, fluid or formula. Average daily dose (preferably given at a single feeding) is 0.3 cc. (5 minims) for infants under one year, and 0.6 cc. (10 minims) for older children.

ABDEC Drops are supplied in 15 cc. and 50 cc. bottles with a special dropper, graduated at 0.3 cc. and 0.6 cc. to facilitate accurate dosage. Each 0.6 cc. (10 minims) contains: vitamin A, 5000 units; vitamin D, 1000 units; vitamin B_1, 1 mg.; vitamin B_2, 0.4 mg.; vitamin B_6, 1 mg.; pantothenic acid (as sodium salt), 2 mg.; nicotinamide, 5 mg.; vitamin C, 50 mg.

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by a plaster of paris cast, split from end to end. This dressing should not be disturbed for a week or ten days unless there is evidence of infection, such as increase of temperature and white blood count, and then only for culture to determine the effectiveness of antibiotics and chemotherapy, or for drainage. This can be accomplished by fenestrating the cast over the wound and carefully lifting the dependent end of the dressings.

Prior to the antibiotic and chemotherapy era, we always left the petroleum jelly dressings on for an indefinite period and let the wound heal by granulation, Orr method. Now, with the aid of antibiotics and chemotherapy, if good surgical toilet has been applied, the wound is clean after five to ten days and ready to accept a split skin graft which will close the defect.

There are always exceptions to these rules regarding primary closure. An important one is that when increased tension will not permit skin approximation and tendons and nerves are exposed, some type of closure usually is appropriate because these tissues disintegrate unless covered. Often a transposition of muscle can be made over the tendons or nerves and a split skin graft applied, or a split skin graft may be placed directly as a dressing.

ANTIBIOTICS AND CHEMOTHERAPY

Experience and knowledge concerning antibiotics and chemotherapy are constantly changing and one must keep abreast of the trends.

As a prophylactic measure 300,000 units of penicillin daily should be used for at least one week and, if infection develops, 600,000 units daily plus 2 gm. of streptomycin if indicated by the bacterial cultures. This may be supplemented with sulfathiazole or sulfadiazine in maximum dosage when the antibiotic therapy is not sufficient.

TREATMENT OF FRACTURE

Because the wound and its healing or closure are of initial importance, little has yet been said about the positioning and immobilization of the fractured fragments.

Length and position need not be sacrificed if the principles of treatment for simple fractures are followed with respect to traction, countertraction, and immobilization of the joints above and below the fracture in plaster of paris casts. Full length of the limb in the position of optimum function is of greatest importance.

To maintain full length, one may have to use traction suspension of the fragments by skeletal traction appropriately applied distant from the wound in the form of Kirschner wires, or external fixation devices. However, these should always be supported by a plaster cast and swung up under an overhead frame with weight and rope pulley suspension.

Except in very unusual instances, skeletal fixation measures are preferable to screws or plates or other internal fixation applied at the time of debridement. Such internal fixation measures may seem very essential, but it is far better to obtain a healed closed wound and then, two or three weeks after the injury, make

Because gradual lowering of blood pressure is so important in hypertension, Nitranitol is almost universally prescribed in such cases. Its gradual action and its ability to maintain lowered pressure for prolonged periods make Nitranitol an ideal vasodilator. Nitranitol, virtually nontoxic, is safe to use over long periods of time. It is available in these four forms:

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- **For extra protection against hazards of capillary fragility.** *Nitranitol with Phenobarbital and Rutin.* (Combines Rutin 20 mg. with above formula.)
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an incision distant from the original wound or in another plane. By such an incision an atraumatic approach may be possible through fascial planes to the fractured fragments, and direct reduction and approximation of the fragments may be accomplished by plate and screws or merely by screw fixation. In compound fractures in the mid-third of the femur, we have successfully used Küntscher intramedullary nails after a delay to insure against infection.

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The Armour Laboratories, a pioneer in the development of medicinal products of animal origin, is keenly appreciative of Dr. Robert Graves' early research on exophthalmic goitre. His contributions to science have assisted greatly in a clearer understanding in the study of thyrotoxicosis and its effect on the functioning of other endocrine glands of the body.

Fifteenth in the series, PORTRAITS OF PIONEERS in Endocrinology. A full-color reproduction of this painting, suitable for framing, is available upon request. On your professional letterhead, please address:

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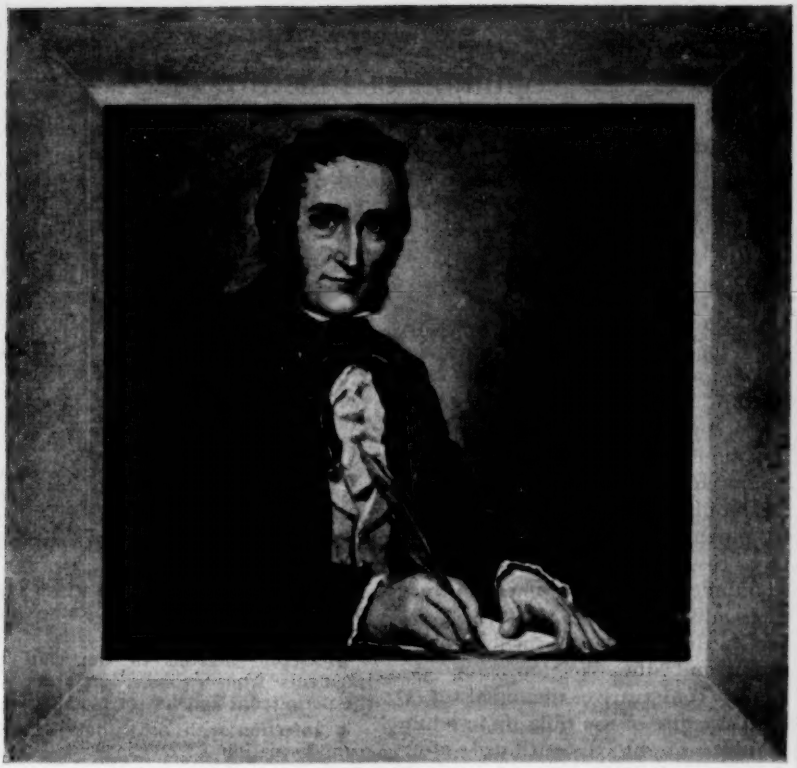


Robert James Graves M. D., 1797-1853

Robert James Graves was born in Dublin on March 27, 1797.* He established an outstanding record at Trinity College. He studied medicine at the School of Physic and also at the College School, and then spent several years abroad furthering his knowledge.

Dr. Graves began practice in Dublin in 1821 and was appointed physician to the Meath Hospital, where he was associated with another great Irish physician, Stokes. He achieved great fame both as a practitioner and as a lecturer and made many valuable original observations and contributions to medical science. He advocated a liberal diet in fevers and suggested that "He fed fevers" be his epitaph.

In 1835 Dr. Graves published a report of 3 cases of exophthalmic goitre. His publication appears to have been preceded by that of Flajani (1800) and of Parry (1825), but his detailed description of the classical symptomatology was so excellent that the term "Graves' Disease" is in widespread use today. Basedow's publication did not appear until 1840—5 years later.

*Some references give his birth year as 1796.

Nonunion of Fractures

SAM W. BANKS, M.D.*
Northwestern University, Chicago

Prepared for Modern Medicine

THE dissolution of continuity of a bone by trauma initiates a process of bone formation which in time should result in union of the fracture. When consolidation does not occur following adequate reduction and a sufficient lapse of time, a nonunion exists.

The differentiation between delayed union and nonunion is not always easy to make. The physician who undertakes the treatment of fractures must be cognizant of the average healing time of such injuries throughout the skeleton. For example, conservative treatment of a shaft fracture of the tibia in an adult should not be discontinued after three months with the assumption that a nonunion exists; the average healing time for this injury is four to six months.

The factors which govern the amount of bone which will be deposited about a fracture are unknown. Sometimes a callus of large proportions will be observed early in the roentgenograms. In other cases no evidence of bone formation appears in spite of accurate reduction and prolonged, uninterrupted immobilization. Unfortunately, we have nothing to administer by mouth or injection that will favorably influence the process of bone formation in a healthy person with a fracture.

The following factors predispose to nonunion:

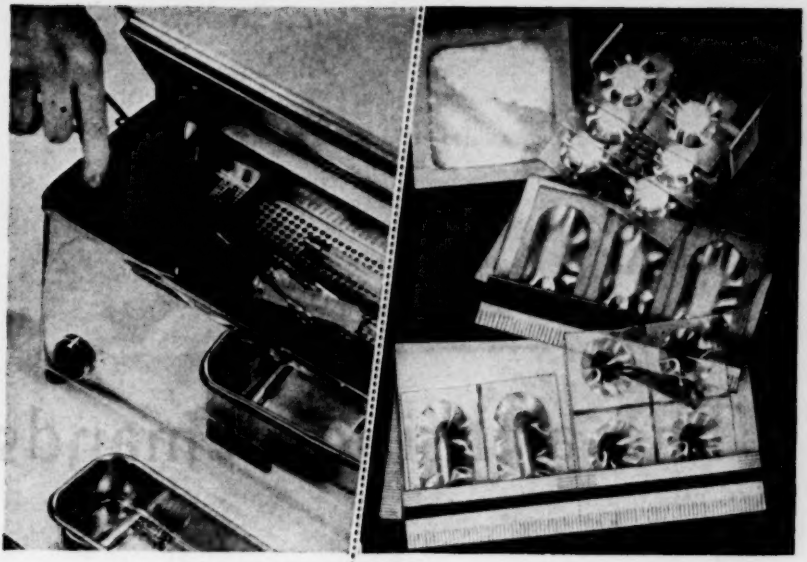
- Inadequate reduction of fragments
- Premature elimination of cast
- Interposition of soft tissues so as to prevent bony callus from bridging the fracture
- Overdistraction, causing bone ends to separate
- Frequent manipulations which suppress bone formation or cause the callus to fracture
- Aseptic necrosis of the ends of fragments from excessive stripping of the periosteum and loss of blood supply
- Infection with or without sequestrum formation

BONE GRAFTS

A bone-grafting operation is the best treatment for an established nonunion. Healing may be expected in 85 to 90% of cases when adequate amounts of bone are placed about the pseudarthrosis. On infrequent occasions, consolidation will occur after the bone ends have been freshened or the ends of the fragments drilled. The application of a metal bone plate does not stimulate bone formation and should never be the sole treatment for nonunion.

(Continued on page 140)

* Department of Orthopaedic Surgery, Northwestern University Medical School, Chicago.



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TYPES OF BONE GRAFTS

► *Multiple chips* of cancellous and cortical bone may be distributed about the fracture site.

► A full-thickness segment of bone can be transplanted to bridge the site of nonunion. The graft may be placed either along the sides of the bone as an *onlay graft* or countersunk into the fragments as an *inlay graft.*

► A combination of these, the *onlay-inlay* technic, is particularly useful at the ends of the long bones where a small fragment cannot accommodate the onlay graft on its surface and the transplant must be placed within the medullary cavity while the other end of the graft is attached to the side of the main fragment.

► The *dual onlay graft,* the fixation of a cortical bone graft by means of screws to two surfaces of the pseudarthrosis, is becoming increasingly popular. The screws traverse successively one graft, the host bone, and the second bone graft. The desirable feature is the vise-like hold on the fragments.

The method is useful at the ends of long bones where the distal fragment has a short projection of cortex and can be held firmly clamped between the two transplants. Dual grafts are effective also in bridging nonunions and total defects in the shafts of long bones.

► *Intramedullary grafts* are seldom used now except in some cases of nonunion of the neck of the femur with viable heads and in small bones of the hands and feet. Other methods are preferable for alignment and fixation of long bones. Intramedullary transplants are relatively small and interfere with intraosseous bone formation by blocking the medullary canal.

The question is often asked if *cancellous bone* is superior to *cortical bone* for transplantation. Cancellous bone has a relatively greater area of exposed surface, and more bone cells should remain viable than in a compact (cortical) bone graft. The cancellous bone should undergo more rapid transformation because of its porosity and the ease of invasion by vascularized connective tissue.

The primary purpose of the graft is to stimulate the ununited fragments to resume bone formation and consolidate the fracture. Once this has occurred, it makes little difference if the graft is replaced rapidly or not. Cancellous bone is excellent for filling partial bone defects and can be used effectively with cortical grafts. The latter offer the advantage of stability, since they can be solidly fixed to the fracture fragments by screws. Large cortical grafts with their cancellous surfaces applied to the host bone unite quickly and are effective in stimulating bone formation.

Cortical grafts should extend a minimum of 1½ in. to either side of the nonunion. Dual cortical grafts 3 in. long are preferable to a single onlay graft of 6 in. Only that portion of the united graft which immediately bridges the nonunion will help stabilize the fracture. Beyond this area the graft serves only to stimulate local osteogenesis.

A dual graft will unite both sides of the fracture and prevent cross

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strains which might fracture a single transplant before the fragments have undergone union. No operation which utilizes cortical bone grafts is complete unless supplemented by multiple cancellous bone chips.

The transplantation of bone for the purpose of obtaining consolidation of nonunions and bridging total bone defects is a reliable surgical procedure when adequately performed in properly selected cases. The outcome may be disastrous when the procedure is attempted by individuals not trained in bone surgery.

PREPARATION

Infection must be eliminated before surgery. Some surgeons consider three to four months after all infection has been controlled to be an adequate waiting period for operation when antibiotics are used.

However, in spite of chemotherapeutic agents and the antibiotics, the percentage of successes will be increased if the wait is extended to six months or more.

Joints become stiffened and the soft parts atrophied and contracted during the cast treatment of the acute injury; immobilization will be necessary following definitive surgery. Physical therapy should be used between procedures to mobilize the joints, loosen the skin, and improve the circulation.

Deep massage over previously infected areas may be helpful in revealing latent organisms. The massage frequently reactivates the infection and thus indicates to the surgeon that surgery is still inadvisable.

Skin coverage is necessary for the success of any bone-grafting operation. The wound may open and permit infection if the skin closure is too tight, particularly in areas like the tibia where the bone is subcutaneous. Broad scars and deep fibrous areas should be excised as a preliminary operation.

Skin deficiencies must be corrected by full-thickness skin. A local double-pedicle flap may be shifted to bring normal skin over the bone, while the resulting soft tissue defect can be covered with a split-thickness skin graft. This procedure can be used at the time of the bone grafting. Transference of full-thickness skin by flaps or tubes is indicated when local skin is inadequate. Since infection is frequently associated with flaps and tubes, it is wise to wait two to three months after the final stage before transplanting bone to the nonunion.

SURGICAL TECHNIC

The type of bone-grafting procedure is determined by the problem, although the general technic is somewhat the same.

The author prefers a pneumatic tourniquet. This conserves blood, prevents shock, and permits work in a dry field. A blood pressure cuff should be used on the upper extremity and can be left in place safely for two hours. There is danger of tourniquet palsy as this period is lengthened.

Special pneumatic tourniquets are available for the lower extremity. Wrap-on tourniquets are unsafe because the pressure on the soft tissues cannot be measured, especially that on the nerves, which are particularly sensitive to pressure when subjected to heavy traction on the frac-

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ture table. Even a pneumatic tourniquet should be avoided here.

The incision should be long enough to expose the deep structures well. All cicatricial tissue is removed from the skin and deeper tissues. The ends of the bones need not be freshened or denuded of soft parts if the fragments are end to end and the alignment adequate.

The fragments are exposed subperiosteally to permit application of an onlay or an inlay graft. The blood supply of the fragments will be less endangered and the alignment more apt to be maintained if the periosteum is not stripped completely around the bone. The graft bed is made along the surface of the fragments by removing the superficial layers of the cortex.

Bone grafts are obtained from the tibia or elsewhere and are applied so as to bridge the nonunion. Multiple cancellous grafts are placed about the main bone grafts. When the fracture is stable and in good alignment, the soft tissues can be closed over the bone grafts so as to make then self-retaining. A plaster dressing is applied to provide external fixation.

When muscle or fibrous tissue has prevented satisfactory reduction, the bone ends must be freed of all soft tissues to permit them to approximate one another. The ends of the fragments should be freshened. When one bone of forearm or leg has failed to unite and excessive bone is removed, a defect will result which is more difficult to treat than a simple nonunion. The fragments are unstable after reduction and onlay bone grafts must be secured by screws or a metal plate, or a rod is used for fixation.

The fragments may appear at first to be securely held by dual tibial bone transplants or the like, but the screws will not continue to hold firmly without a cast. This must extend beyond the joint above and below the site of nonunion. Immobilization is continued until roentgenograms show a union.

Some fractures are stable with only the use of internal metal fixation. This allows the patient to mobilize stiff joints. Lane plates used singly or in pairs with a bone graft do not offer adequate fixation without a cast.

Intramedullary rods give adequate immobilization to fractures of the femoral shaft and preclude the necessity of a hip spica cast. The combined use of rods and onlay bone grafts, cortical and cancellous, is increasingly popular for some nonunions of the femur. Metal flanges afford adequate fixation for nonunion in the trochanteric and supracondylar regions of the femur.

Blood should be given during the operation to minimize the occurrence of shock when the tourniquet is released and there is a sudden extravasation of blood into the site of operation. Patients should receive 2 or more units of blood during massive procedures. Penicillin, streptomycin, or both are administered on the day before surgery and for five to seven days afterward.

INDIVIDUAL PROBLEMS

Humerus—Pseudarthrosis of the humerus is rarely encountered at its proximal end. Consolidation of the

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acute fracture fails to occur on occasions in spite of the fact that the fragments are end to end.

The proximal small fragment rarely accommodates the application of an onlay bone graft. The most effective procedure is to pass a full-thickness transplant through the medullary canal of the proximal end of the distal fragment after a window has been made in the bone, so that the graft enters the central portion of the head fragment. When the fragments are widely separated, they are denuded of soft tissues to a sufficient degree to be realigned. An onlay, onlay-inlay, or intramedullary graft can be used.

Total defects in the shaft of the humerus are best handled by shortening the bone to approximate the fragments and use of an appropriate bone graft. Function will not be materially impaired and the cosmetic defect is rarely noticeable.

Pseudarthroses of the shaft of the humerus are treated by onlay bone grafts. In the supracondylar region a cortical bed may be prepared for the graft by removing a portion of the epicondylar ridge and adjacent bone of the lateral condyle. The distal fragment is brought upward through the lateral incision and, after the graft has been fixed to it by screws, the nonunion is reduced and the graft attached to the proximal fragment.

Nonunion of the individual condyles of the humerus is rarely corrected. Operation is indicated for disabling pain or instability. Surgery should be avoided if the function is good and the mechanism painless. Motion is unlikely to be improved by surgery, and arthrodesis may be the operation of choice.

Olecranon—Small ununited fragments of the olecranon process are treated by excision of the avulsed fragment and repair of the triceps tendon. Function can be quickly restored with excellent results.

When the nonunion is located in the distal half or third of the process, treatment requires a bone graft. Excision of too large a fragment may cause anterior dislocation of radius and ulna. The olecranon is exposed subperiosteally through a dorsal incision and the fragments are freshened, brought into proper alignment, fixed by metal, and then an onlay bone graft is applied. Care must be taken not to expose the lateral side of the olecranon too extensively to avoid union with radius.

Radius and ulna—Nonunions are frequently encountered in the forearm bones. When both are involved they must be exposed through separate incisions and each grafted as a unit. The ulna is easily exposed through a posterior incision over its crest. The radius is more difficult to expose and one must know the several different incisions which will uncover a specific portion or surface of it.

The author prefers onlay tibial transplants held by metal screws for nonunions of the radius and ulna. Full-thickness fibula grafts are excellent for total defects in the shaft of the radius. Defects in the ulna correct well with dual bone grafts. Total defects of the radius which include the distal articular surface can be corrected by full-thickness tibial transplants which arthrodese

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the wrist by contacting the carpal bones.

Hand—The navicular bone is a common site of nonunion. When both fragments are viable, an intramedullary bone graft may correct the defect and restore good use of the wrist.

The other bones of the carpus are but rarely the site of nonunion. Nonunion occurs in the lunate, often secondary to aseptic necrosis. Excision of the entire bone is the treatment of choice.

Nonunion of the metacarpal bones is correctable by inlaid bone transplants. Total defects are treated by the transplantation of blocks of iliac bone so as to restore maximum length of the bone. Stability can be obtained by multiple Kirschner wires which pass through the graft into the adjacent metacarpal bones. The wires are placed so their ends are beneath the skin. This will facilitate subsequent removal.

Rarely is bone grafting required for nonunion of a phalanx. One can step-cut the fragments so as to bring a surface of viable bone into contact and obtain union. If this will cause an excessive amount of shortening, a key type of inlaid graft can be used.

Femur—Nonunion of the neck of the femur occurs in approximately 15 to 20% of fracture cases. An effort should be made to preserve the head if viable.

Use of intramedullary bone grafts which traverse the neck and pass into the head is a good method to obtain consolidation of the pseudarthrosis. Internal fixation by a Smith-Petersen nail or by multiple threaded wires precludes external fixation by plaster.

A McMurray osteotomy is essentially a bone-grafting operation although the weight-bearing alignment is changed simultaneously. The cut proximal end of the shaft is placed beneath the pseudarthrosis and serves as an onlay graft. As union occurs, the fibrous tissue of the nonunion may undergo ossification.

Fractures at the junction of shaft and trochanteric region of the femur not infrequently fail to unite. Treatment consists in freshening the bone ends, realigning the fragments, inserting a blade plate, and applying full-thickness tibial bone grafts across the front and back of the nonunion. A hip spica cast may be necessary for eight to ten weeks if the bone is osteoporotic and the plate unlikely to hold.

A common location for nonunion is the middle third of the shaft of the femur. Everyone advocates a massive bone transplant, but recommendations vary as to the procedure. The author prefers an intramedullary rod. This maintains alignment and stability of the fracture while transplanted bone about the pseudarthrosis stimulates union. No cast is necessary, and the patient may be on crutches swinging the extremity after two weeks. The method is especially useful when the knee joint is already stiff and further immobilization in plaster is deemed to be undesirable.

Supracondylar fractures of the femur have a high rate of healing but nonunions occur. Open reduction and a bone graft are indicated. A metal flange fixed to the side of

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the shaft while the blade enters the condyles is a recent refinement in technic.

Nonunions of the femoral condyles must be corrected for they cause pain, instability, and bowing. The freshened fragments are realigned and fixed by screws, bolts, or other types of metal. An onlay-inlay will stimulate osteogenesis and promote healing.

Patella—Nonunion of the patella should be treated by excision of the smaller fragment instead of by bone grafting. The recovery period will be materially shortened and the possibility of late arthritis will be minimized.

Tibia—No bone offers the surgeon more difficult nonunions than the tibia. Postoperative complications are numerous due to infections and slough of overlying skin permitting the bone to become exposed.

Nonunion at either end of the tibia may be grafted by the inlay or the onlay-inlay method. The single onlay, the dual onlay, or the sliding inlay bone grafts are useful for shaft problems. The author prefers dual grafts of full-thickness tibial bone.

When the ends of the fragments are sclerotic, a sliding inlay graft will help restore osteogenesis, but union is more likely to occur if a graft is also placed along one or two other surfaces of the pseudarthrosis. A long leg plaster cast is used until there is roentgen evidence of union.

Foot—Nonunions in the foot rarely cause sufficient symptoms to require corrective surgery. The same general principles apply when bone grafting is indicated as noted for the hand.

What Would You Say?

Twice a month we will select a caption for this cartoon from those sent in by our readers and send the author $5. This caption was written by

James M. King, M.D.
Tullahoma, Tenn.

Mail your caption to The Cartoon Editor, MODERN MEDICINE, 84 South 10th St., Minneapolis 3, Minn.

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Reconditioning after Fractures

MARCUS J. STEWART, M.D.*
University of Tennessee, Memphis

Prepared for Modern Medicine

SINCE Roentgen's discovery of x-ray, the primary consideration in estimating the end results of fractures has too often been based upon the appearance of the bones in the final set of films.

It is gratifying, therefore, to note that the present trend of treatment is toward the restoration of an individual as a whole to a self-supporting, productive part of society. The initial consideration is, of course, the selection of the best method of treatment, one that will adequately immobilize the fracture but permit early restoration of function of all tissues in the involved area, while allowing maximum activity for the remainder of the body.

If the blood supply to a bone is abundant, immobilization need be less rigid and rapid healing can be anticipated. Callus and new bone formation, in the presence of an ossifiable medium and a calcific surcharge, will be produced in direct proportion to the adequacy of the blood supply to the part.

Active muscle contractures increase the flow of blood through a muscle by 6 to 9 times. Further, the initial reflex—the increase in the blood supply in the contracting muscle—increases the blood volume to other inactive muscles. Early active exercise, therefore, is a very important factor in stimulating the production of new bone and in decreasing the healing time of fractures.

Consider the fractured rib or clavicle, where the blood supply is abundant and muscle activity is continuous: Nonunion is rare. Little over a decade ago, fractures of the humerus produced the highest incidence of nonunion of long bones. Now, with the advent of the hanging cast, which deviates in principle by traction and active exercises from former methods of treatment, nonunion of the humerus has become exceedingly rare.

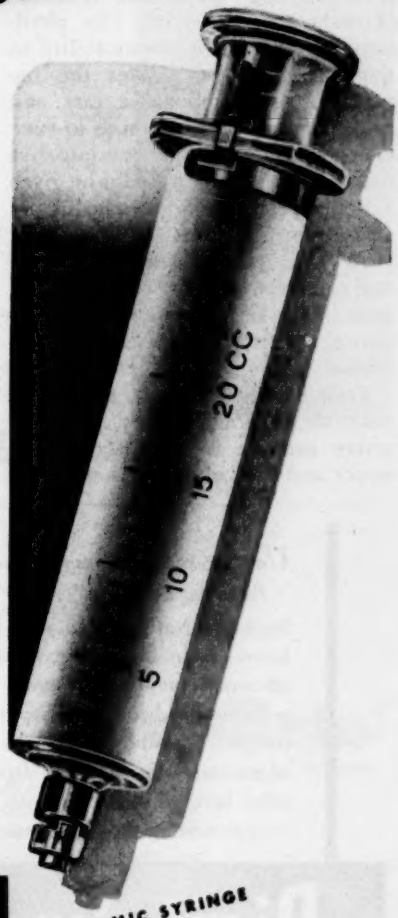
RECONDITIONING BEGINS

It is a common impression that reconditioning begins as soon as the patient is ambulatory or as immobilization is discontinued. If this teaching is followed the patient is deprived of many valuable and productive weeks and months. Reconditioning should begin when the fracture occurs, for it is far better to preserve function than to restore it.

From the beginning, treatment should be based on a program that will adequately immobilize the injured part and, at the same time, main-

* Department of Orthopaedic Surgery, University of Tennessee College of Medicine, Memphis; Campbell Clinic, Memphis.

you buy FUNCTIONS!



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tain good tissue turgor and a properly functioning vascular tree by means of early active exercise. The physician has as great a responsibility to impress upon the patient the importance of postoperative care and proper muscle reeducation as to exercise good surgical and manipulative technic. Each patient should be given a definite and detailed schedule of active remedial exercise. The doctor must gain the patient's confidence and complete cooperation in this program. His keynotes should be patience, sincerity, enthusiasm, and optimism.

Early ambulation, per se, though desirable, is not necessary, but early active exercise is essential. Recumbency and lack of active exercise are conducive to a multitude of local and general complications: poor circulation, embolism, pulmonary and cardiac congestion, osteoporosis, and poor callus. The metabolites of the body, especially of the muscles, undoubtedly play a more important role in the production of new bone than has ever been explained.

Dock[1] states: "Thrombosis is the most frequently fatal sequel of complete bed rest, and the common cause of serious pulmonary complications. Hypostatic bronchopneumonia is second in frequency, and is a more complex problem in which recumbency plays a contributing role of importance." Moreover, nitrogen balance can seldom be established, even with

(Continued on page 158)

Until mechanical means for winding-up the failing heart exist, consider this:

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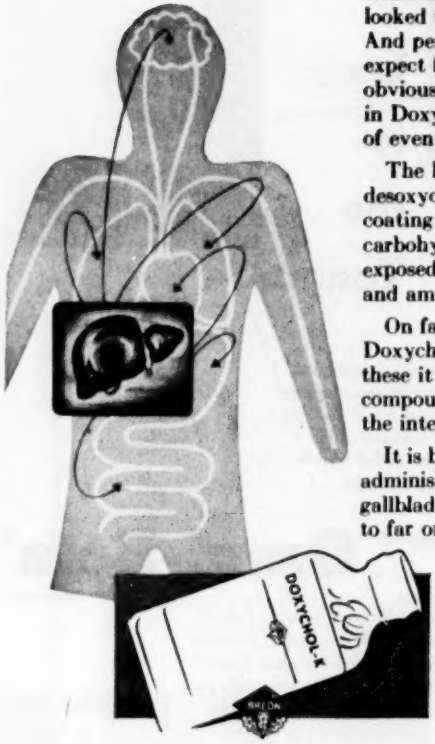

The bile acids are expected to drain and flush the biliary tract; to bring help against stasis and cholecystitis. Too, they are looked to for the vital digestion of fats. And perhaps these benefits are enough to expect from one agent. But truth is, the less obvious effects that flow from the bile acids in Doxychol-K may be for some patients of even greater importance.

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a high-protein diet, in the presence of inactivity and recumbency.

Ghormley[8] pointed out that, although the pathologic physiology of atrophy is not understood, the condition occurs from prolonged rest, and that not only bone is involved, but all soft tissues. Normally, tendon sheaths and fasciae present a smooth, glistening, gliding surface, but with prolonged immobilization, adhesions develop and muscles become dull and anemic.

STEPPING STONES TO RECONDITIONING

1] Enthusiastic desire of patient and doctor to restore and maintain the best possible function of the affected part.

2] Immediate and continual elevation of the part during the first few days after injury.

3] Conscientious and enthusiastic execution of a program of early, active, non-weight-bearing and weight-resisting exercises.

4] Conscious maintenance of good posture, systematic deep breathing, and intelligent body mechanics.

5] Application of heat, massage, and special apparatus in selected cases.

According to McBride, in *Disability Evaluation*,[9] the objectives of reconditioning may be summarized as:

- Quickness of action.
- Coordination of movements.
- Strength—physical energy and force.
- Security—trustworthiness and reliability of the injured part.
- Endurance of the part and of the whole.

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A SPECIFIC PLAN

The objective should be *dynamic physical reconditioning;* that is, specific for the therapeutic need of the individual part, in contrast to general physical reconditioning or calisthenics. The latter is important and essential to maintain the individual as a whole, but the specific effort must be directed toward sedulous reconditioning of the injured member.

The patient must be taught three important phases of muscle reconditioning: [1] contraction, [2] sustained contraction, and [3] complete relaxation.[4] This cycle should be strictly adhered to during each exercise period. Instructions must be specific as to when, how, and what amount of exercise is to be taken and that it be taken in a progressive, intelligent manner.

The initial exercise period should be one of static contractions to overcome alienation and learn proper control of muscle groups. This muscle setting exercise is begun not later than the third day after reduction and, in many cases, may be started on the day of the injury.

As a specific example for reconditioning, let us consider a case of fracture of the lower leg. Initially, a count of 10 static contractions repeated four or five times each day

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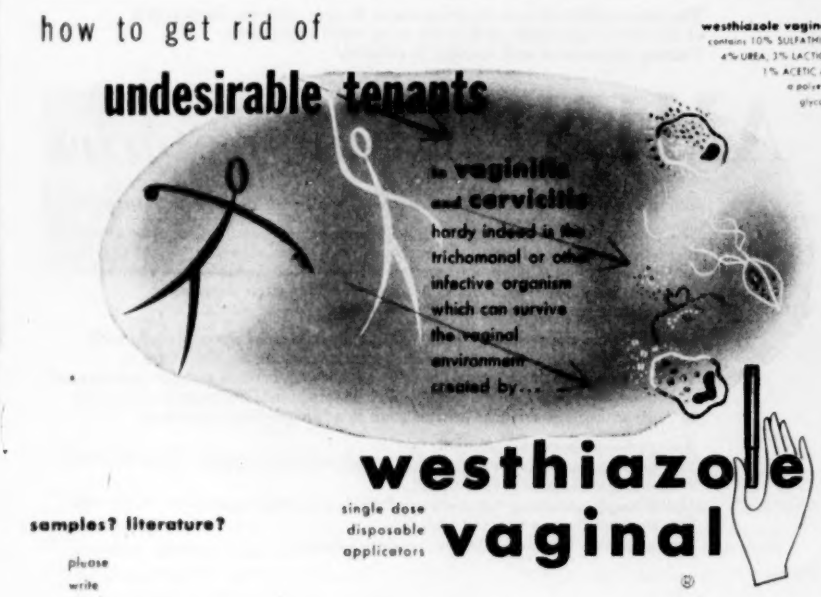
is sufficient, but this should be increased until a count of 50 can be accomplished.

Next, stiff leg raising is started and the cycle of 10 to 50 is repeated; this exercise is continued until the fracture is healed and all external support has been removed. Now the patient is ready to begin flexion exercises of the knee in the same routine count. Weight resistance may be added to the pull of gravity, using first 5, then 10 lb. A convenient method is to fix sand in saddlebag fashion and hang over the dorsum of the foot.

When the knee can be extended 50 times against 10 lb. of resistance, motion in the joint will be good. Barring mechanical interference, motion in the joint will return in direct proportion to the strength of the musculature controlling that joint.

If more muscle strength and power are required, as in the case of an athlete, soldier, or laborer, heavier resistant or power-building exercises are used; in these the goal is to raise 25 lb. 25 times. While emphasis is placed on quadriceps exercises, a similar program should be outlined for the hamstrings and all other muscle groups of the extremity. Written instructions and personal demonstrations of the various exercises should be given by the doctor or a qualified physical therapist. However, the responsibility of perfecting the program and following the progress of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the patient rests squarely on the doctor.

With injuries of the upper extremity it is paramount that active motion in the fingers and the metacarpophalangeal joints be practiced every hour of the day. When the strength of the hand is increased, the circulation and tissue turgor of the entire arm improve. This helps prevent venous and lymphatic stasis, which would produce serofibrinous exudate and adhesions. As Watson-Jones[8] states, "It is not immobilization alone which causes joint stiffness, it is immobility and functional disuse."

After removal of external support, exercise of the hand and all muscle groups in the arm is continued.

An extremely important feature in reconditioning of the upper extremity is *never* to force motion in an elbow or finger. The erroneous practice of having the patient carry a bucket of sand or weight to assist in forcing extension of the elbow is wrong in principle and will only result in increased fibrosis and ossification about the joint.

Movement of a joint is not necessary for active contraction of every muscle traversing that joint. For example, a patient with a fractured spine who is immobilized in a body plaster can condition the musculature in the erector spinae groups so that when the plaster is removed, several months later, the musculature will be stronger than before the injury.

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A comminuted fracture of the femur treated by this method often is sufficiently healed in ten weeks to allow discontinuance of all immobilization. With the advent of intramedullary pin fixation for fractures of the femur, more vigorous and sedulous muscle exercise is allowed and callus formation is more rapid than in any previous form of treatment.

There is no longer any question as to the importance or practical value of early active exercise, early ambulation, and weight-resisting exercises. All physicians should be cognizant of the means of early restoration of function through proper rehabilitative measures.

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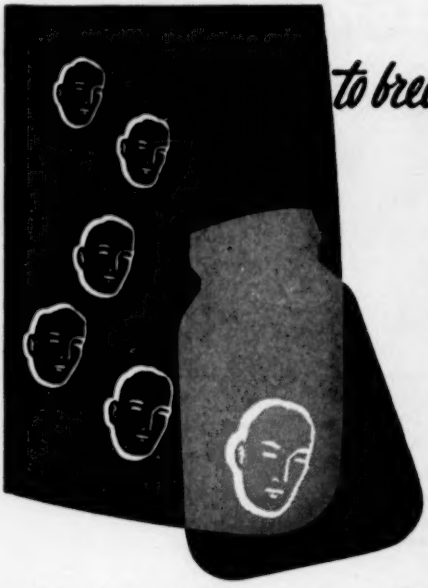

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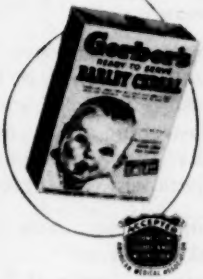

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Fractures: Medicolegal Aspects

LOUIS J. REGAN, M.D., LL.B.*
College of Medical Evangelists, Los Angeles

Prepared for Modern Medicine

TREATMENT of fractures is hazardous. More malpractice claims, and consequent costs, arise out of fracture care than from any other service rendered in the entire field of medical practice.

A ten-year survey of malpractice litigation in one metropolitan area discloses that about 30% of the total sum spent in costs, settlements, and judgments was expended in disposing of fracture claims. However, very few claims, and almost none of merit, are brought against the orthopedic specialist.

In studying fracture claims, certain impressions are inescapable:

1 The attending physician is frequently too optimistic in his approach to the care of a fracture case. The prognosis is too favorable and the patient is not properly impressed with the seriousness of the condition.

2 Not uncommonly, the area of the x-ray search is too limited. Instances are recorded wherein, with a fracture of the neck of the femur, roentgenograms were made of only the unfractured shaft, and vice versa. In multiple fractures, sometimes not all the fractures are discovered.

3 Impacted fractures, especially of the neck of the femur, are at times not diagnosed even when suggested by the roentgenograms.

4 X-ray study is not used at all or is insufficiently used. Too often, for example, only an anteroposterior film is made.

5 The psychologic attitude of the patient is not sufficiently regarded. When faced with the end result, the patient does not recall the extremity as presented to the doctor, but as it was prior to the injury.

6 Poor judgment is sometimes exercised in the choice of method of treatment, closed as against open reduction, for instance.

7 At times, improper, ineffective, insufficient, badly positioned, or too tight immobilization is effected, sometimes with catastrophic result—nonunion, deformity, functional limitation, ischemic paralysis, or gangrene.

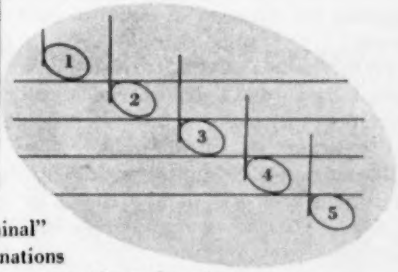
A number of fracture cases are briefly reviewed as follows:

► A diagnosis was made of fracture of the right foot and sprain of the back, but a fracture of a lumbar vertebra was not discovered. No roentgenogram of the spine was made.[1]

► A surgeon diagnosed a fracture of the upper third of the femur but

* Professor of Legal Medicine, College of Medical Evangelists, Los Angeles; Legal Counsel, Los Angeles County Medical Association.

variations on a theme...



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Dosage: **One to three capsules daily or as directed by the physician.**

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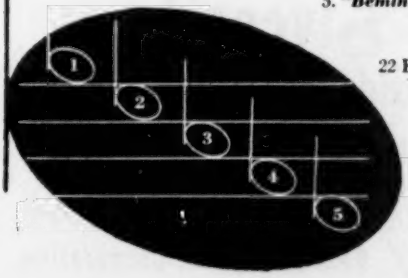

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failed to notice or give any treatment for a break of the neck of the femur. The necessary operations and injuries caused by this oversight were held sufficient to entitle the patient to a judgment for damages in a malpractice suit.[3]

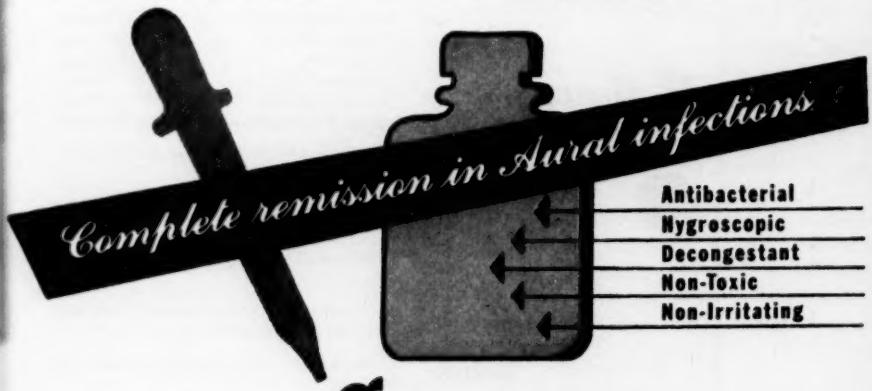
► A physician was held liable for diagnosing a fracture as a dislocation. No roentgenogram was made.[3]

► A physician was held liable when a fracture of the surgical neck of the humerus was present and diagnosed, but a fracture of the elbow was overlooked.[4]

► A patient had a dislocation of the shoulder, which was diagnosed. The use of x-rays was advised and refused. Multiple fractures about the shoulder were not discovered.[5]

► In setting and treatment of a broken leg, the surgeons exercised ordinary care and skill but, when the patient was discharged, gave him no instructions. The leg soon became bent and had to be amputated. Failure to give instructions as to the care of the leg was held as negligence for which the defendants were liable.[6]

► Evidence was given that, after putting a child's broken leg in a cast, pain, infection, and loss of feeling in toes developed; that surgeon refused to examine cast; that he left for a week without notifying patient or procuring a substitute; that he subsequently failed to respond to call for assistance, though he had not released the case or been discharged;



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Treatment of the Parkinsonian syndrome with PANPARNIT was observed by Schwab and Leigh[1] "to be superior to the previous medication" in 65% of cases. With a careful regimen of gradually increasing dosage, "very satisfactory results with this new compound will follow."

By reducing rigidity and tremor PANPARNIT frequently enables the Parkinsonian patient to resume a more nearly normal life . . . to perform simple daily tasks, to feed, to shave, and to dress himself. Improvement of physical status leads to increasing self-reliance and a happier frame of mind—a major step toward mental as well as physical rehabilitation.

A totally new synthetic drug, PANPARNIT offers the advantages over the belladonna alkaloids of frequently affording more satisfactory relief and rarely causing disturbances of vision or dryness of the mouth.

1. Schwab, R. S. and Leigh, D.: *J.A.M.A.* *139*:629, 1949.

Geigy

Fuller information regarding clinical studies and suggested dose schedules will be furnished gladly.

PANPARNIT (caramiphen hydrochloride): Available as sugar-coated tablets 12.5 mg. (bottles of 100) and 50 mg. (bottles of 50, 250 and 1000).

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REGURGITATION IN INFANTS

EPIDEMIC VOMITING

EMETROL

Trademark

PHOSPHORYLATED CARBOHYDRATE SOLUTION

FEATURES OF EMETROL*

IMPORTANT:

that, through undue pressure of cast, necrotic spots developed which resulted in cellulitis and rendered amputation necessary. This evidence sustained verdicts for the infant patient and for the father suing for loss of services and for expenses.[7]

Every fracture should be carefully appraised and the patient, or someone on behalf of the patient, fully informed as to the result, cosmetic and functional, which is to be reasonably anticipated. The physician must not promise, "It will be just like it was before the accident."

As to the physician's legal duty, the courts' declarations in certain cases are noted:

1 A physician is under a duty to recommend someone better qualified than himself to give treatment if the patient's condition requires it.[8]

2 A physician, besides selecting a recognized and approved method of treatment, must use that degree of care ordinarily exercised by reputable physicians in the same locality in pursuing that method.[9]

3 In determining a physician's liability for malpractice, the test is whether the physician exercised that degree of care which, under all the facts, would ordinarily have been exercised by a physician practicing his profession in a similar locality.[10]

4 A patient treated by a physician is entitled to a thorough and careful examination such as the patient's condition and the attending circumstances will permit, with such diligence and methods of diagnosis as are usually approved and practiced by medical men of ordinary or average learning, judgment, and skill in that community or similar localities.[11]

5 In a California case,[12] the court said: It might almost be stated that use of the x-ray as an aid to diagnosis, in cases of fracture, was a matter of common knowledge, and that the court could, in the absence of testimony, take judicial notice of this scientific advancement."

6 Evidence presented question for the jury as to whether physician was guilty of negligence in making only one roentgenogram of plaintiff's spine during diagnosis of her case and in failing to discover a compressed fracture of the vertebra.[13]

7 Evidence that physician diagnosed patient's injury as merely a bruise, that he failed to have roentgenograms made though a possible fracture was indicated, and that the patient was in fact suffering from a fracture established a prima facie case against the physician.

A physician does not impliedly guarantee the results of his treatment. He may unwisely, by special contract, warrant the results and thereby render himself liable to accomplish the promised result, but he is not an insurer of results unless he makes, himself one by contract.

No physician is immune to a malpractice suit. The incidence of malpractice claims has risen to such a high level that any physician is unwise if he fails to take all precautions to safeguard himself. Exercise of even the highest degree of skill

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Upset stomach, due to excess acidity, can be relieved quickly and effectively with the aid of modern BiSoDoL. The balanced combination in the BiSoDoL formula provides these important advantages in the treatment of gastric disturbances:

√ Acts **fast**
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√ Pleasantly flavored—easy to take

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tablets or powder

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and care may not ward off the unjust claim. The employment of a consultant in the instance of a bone or joint injury affords great protection to the attending physician.

Probably three-fourths of all malpractice suits are precipitated by the criticism of succeeding physicians of the work of their predecessors. The elimination of unethical criticism is obviously of primary importance. Legitimate criticism can rest only on full knowledge of the facts as gathered from all the parties—from the physician who treated the patient, as well as from the patient.

The individual practitioner should give more serious thought to the malpractice problem. The expenditure of a small amount of time and study will enable him to know his legal duty to his patient. When the physician understands the hazards of the relationship, he is able to safeguard himself so that it becomes practically impossible for any patient to maintain an unjust malpractice action against him.

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3. Trial Court.
4. Trial Court.
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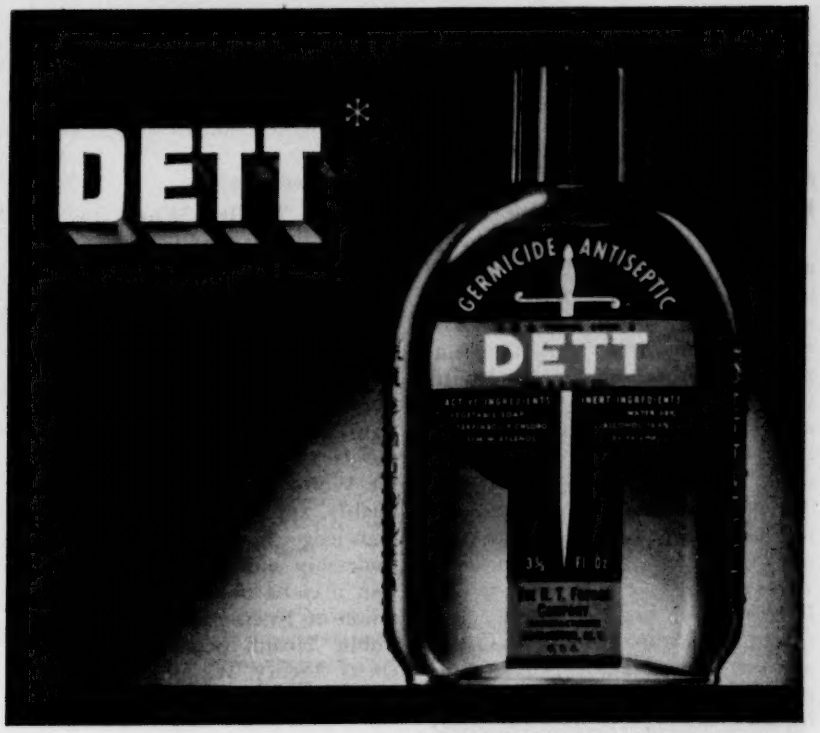
7. Vann v. Harden (Va.), 47 S. E. (2d) 314.
8. Mernin v. Cory (Calif.), 79 Pac. 174.
9. Church v. Bloch (Calif.), 182 Pac. (2d) 241.
10. Nation v. Gueffroy (Ore.), 142 Pac. (2d) 688.
11. Fortner v. Koch, 272 Mich. 273.
12. Reynolds v. Struble (Calif.), 18 Pac. (2d) 690. See also Jacobson v. Massachusetts, 197 U.S. 11.
13. Mason v. Hall (Ga.), 35 S.E. (2d) 478.



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Dett, although deadly to germs, is gentle to human tissue. This clean, clear liquid with an agreeable odor is safe, effective, non-irritating and non-staining. Physicians who have used Dettol in other countries will welcome its introduction in the United States under the name of Dett.

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DETT *THE MODERN WEAPON AGAINST INFECTION*

Short Reports

JOINT DISEASES

Pregnenolone for Arthritis

Remission of rheumatoid arthritis may be obtained with delta 5 pregnenolone. Dr. Roland Davison and associates of Stanford University, San Francisco, find, however, that improvement may not appear until three or four weeks after the beginning of treatment and that symptoms usually reappear within a few days after withdrawal of the steroid. The effective daily dose is 200 mg. intramuscularly. Once symptoms subside, effects may be maintained by 100 mg. daily or every other day. Pregnenolone acetate in oil gives more satisfactory results than an aqueous suspension of crystalline pregnenolone. Although ACTH and cortisone act more rapidly, pregnenolone is less expensive and free from toxic effects even over a long period of administration.

Arch. Int. Med. 85:365-388, 1950.

RESEARCH

Fishbein Memorial Laboratory

A center for the study of rheumatic disease, the Morris Fishbein, Jr., Memorial Laboratory has been established at La Rabida Jackson Park Sanitarium, Chicago. Dr. and Mrs. Morris Fishbein have contributed $37,500 to a fund set up under the Chicago Heart Association to equip the laboratory in memory of their son.

PUBLIC HEALTH

Overseas Health Work

Health personnel is being recruited for technical missions overseas by the Division of International Health, U.S. Public Health Service. Physicians, scientists, health educators, sanitary engineers, sanitarians, nurses, administrators, and technicians will be employed by either the U.S. Public Health Service or the World Health Organization. To qualify, applicants must have expert knowledge in their own field and leadership ability. Further information may be obtained from the Division of International Health, U.S. Public Health Service, Federal Security Agency, Washington 25, D.C.

AVIATION MEDICINE

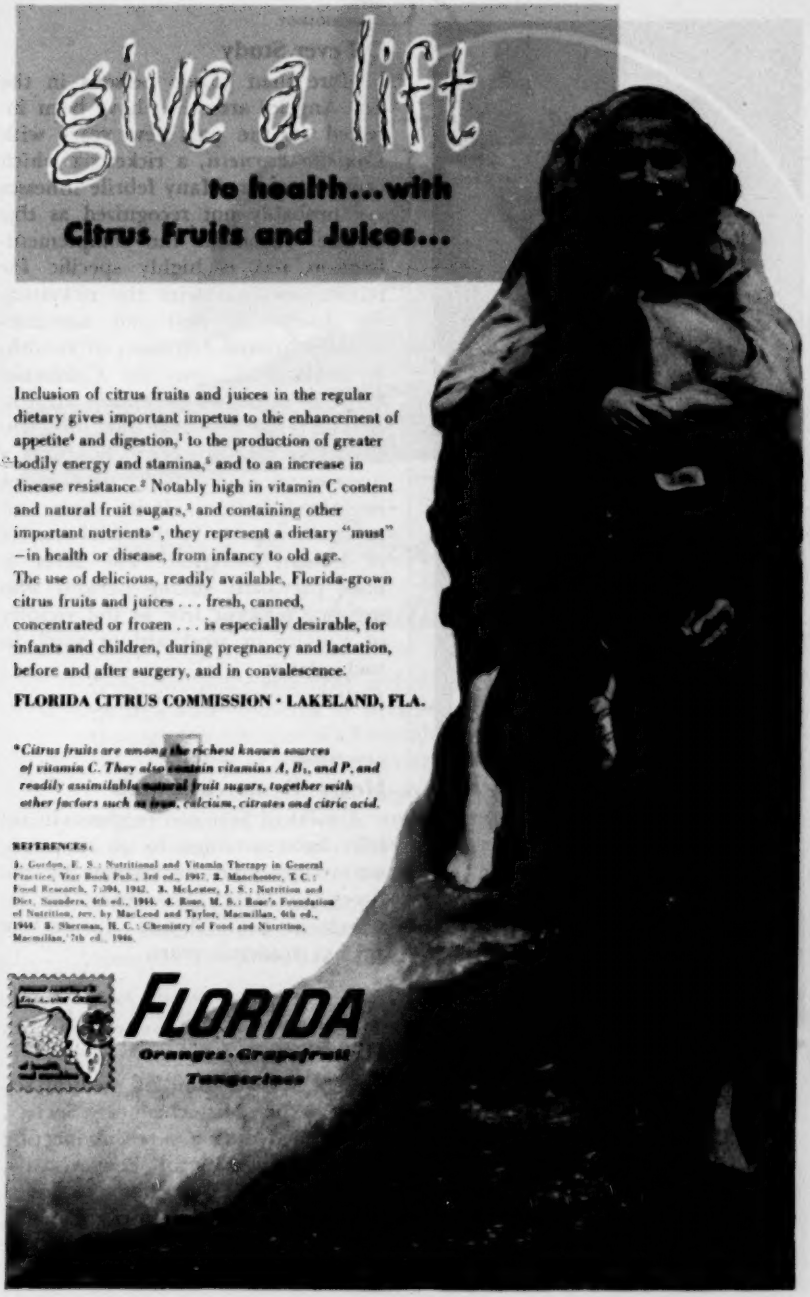
Prevention of Airsickness

Benadryl and Dramamine in dosages of 50 and 100 mg., respectively, appear to be equally effective in preventing airsickness. Drs. Herman I. Chinn and Fred W. Oberst of the USAF School of Aviation Medicine, Randolph Field, Tex., find that 0.65 mg. of hyoscine hydrobromide, the drug most often used for this condition, and 50 mg. of Benadryl, given in combination, are more effective than either drug used alone. Even when airsickness is not prevented, the onset of vomiting is delayed by Benadryl.

Proc. Soc. Exper. Biol. & Med. 73:218-219, 1950.

give a lift

to health...with Citrus Fruits and Juices...



Inclusion of citrus fruits and juices in the regular dietary gives important impetus to the enhancement of appetite[4] and digestion,[1] to the production of greater bodily energy and stamina,[5] and to an increase in disease resistance.[2] Notably high in vitamin C content and natural fruit sugars,[3] and containing other important nutrients*, they represent a dietary "must" —in health or disease, from infancy to old age.

The use of delicious, readily available, Florida-grown citrus fruits and juices . . . fresh, canned, concentrated or frozen . . . is especially desirable, for infants and children, during pregnancy and lactation, before and after surgery, and in convalescence.

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**Citrus fruits are among the richest known sources of vitamin C. They also contain vitamins A, B_1, and P, and readily assimilable natural fruit sugars, together with other factors such as iron, calcium, citrates and citric acid.*

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FLORIDA

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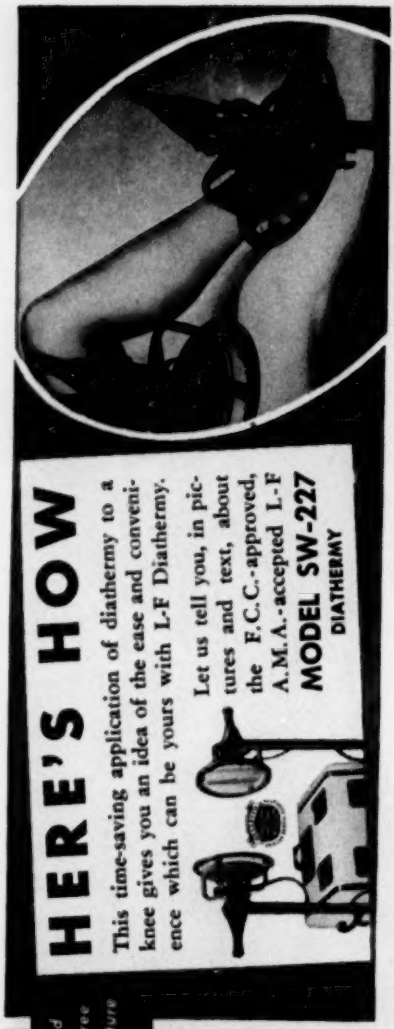
Tangerines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EPIDEMIOLOGY

Q Fever Study

More than 50,000 persons in the Los Angeles area may have been infected in the past few years with *Coxiella burnetii*, a rickettsia which causes Q fever. Many febrile illnesses are probably not recognized as this disease. Although the complement-fixation test is highly specific for recent infection with the rickettsia, Dr. Joseph A. Bell and associates of the National Institutes of Health, Bethesda, Md., and the California State Department of Public Health, Berkeley, believe that the low sensitivity of this procedure produces a disproportionately large number of negative reactions. Dairy cows and products seem to be the chief sources of human infection. The fever is most prevalent among persons who use raw milk or live in the vicinity of a dairy or stockyard or work in such plants.

J.A.M.A. 142:868-872, 1950.

CARDIOLOGY

Heart Research Funds

A total of $220,000 in grants-in-aid have been awarded to 46 hospitals, universities, and institutions by the American Heart Association for research in heart disease during the 1950-51 academic year.

ORGANIZATIONS

Histochemical Society

A new association of medical scientists, the Histochemical Society, was formed during a recent meeting at the University of Pennsylvania, Philadelphia. Delegates attended from the United States, Canada, Great Britain, Mexico, and Argentina.

during the Period of Nausea and Vomiting of Pregnancy

Sempylex is a convenient and highly effective means of controlling nausea and vomiting of pregnancy. Exerting its action chiefly through the influence of its contained pyridoxine, it markedly reduces the discomfort of emesis gravidarum and permits normal eating.

Sempylex also provides appreciable amounts of glucose together with thiamine, riboflavin, and niacinamide to further aid in the liver storage of glycogen. This approach also combats the frequently associated acidosis and impaired liver function.

Used early in pregnancy Sempylex frequently prevents nausea and vomiting from assuming serious proportion. Dosage, one tablespoonful four times daily.

Each fluidounce of Sempylex contains:	
Pyridoxine hydrochloride (B_6)	35 mg.
Thiamine hydrochloride (B_1)	10 mg.
Riboflavin (B_2)	10 mg.
Nicotinamide	25 mg.
Glucose	20 Gm.
Aromatic aqueous vehicle	q.s.

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PANASAL, "Ulmer" offers an effective approach to the treatment of arthritis, rheumatism and rheumatic fever. PANASAL, "Ulmer" given orally, permits the high salicylate blood levels formerly obtainable only by intravenous injection under hospital care.

Each PANASAL "Ulmer" Tablet contains:

Sodium Salicylate
.....0.25 Gm. (3.85 gr.)

Para-aminobenzoic Acid
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INDICATIONS:

Rheumatic fever, arthritic conditions, rheumatism, neuralgias, myalgias, and such other conditions as are amenable to salicylate therapy. PANASAL "Ulmer" is particularly aimed at assuring high therapeutically effective blood levels of salicylates for the treatment of these conditions.

Write for booklet MM-550 on *The Treatment of Rheumatism, Arthritis and Rheumatic Fever with Panasal "Ulmer."* This booklet is available free on request, and gives the rationale of this new treatment method, indications, dosage regimen, etc. A new bibliography is included.

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"Although E.C. 110 (CAFERGONE) was developed primarily for the relief of the migraine attack, it is uniformly effective and has a much wider range of usefulness in the relief of headache of all other types, especially typical and atypical histaminic cephalgia."
(Hansel)[1]

or The First Time In Almost Two housand Years, clinical trials of an al preparation indicate that migraine nd other vascular headaches can be orted in 85-90% of cases.

lthough the cause of migraine is still nknown, the mechanism productive of ead pain has been determined.[2] It has een observed that the head pain in mi-raine and related disorders is produced y abnormal behavior of certain cranial teries, principally branches of the ex-rnal carotids. These become con-tricted in the pre-headache stage of the ttack, producing warning signs such as isual disturbances. Later, these arteries ilate and *at this point, agonizing head-che begins.* Exaggerated pulsations and hickening of the affected arterial walls ause stretching of and pressure upon djacent pain-sensitive structures. Head-ches of this type may last for a few min-tes only or they may last for days. eizures usually terminate with severe omiting.

s a result of recent research, these eadaches can be aborted for the great najority of sufferers. *Attention has been entered on the development of an ef-ective oral preparation to relieve vas-ular headaches. Cafergone* (100 mg. affeine and 1 mg. ergotamine tartrate er tablet) *is the result of this research.* rgotamine tartrate (Gynergen) has ong been known as a potent vasocon-strictor.[3] Caffeine, when administered orally, also acts as a vasoconstrictor.[4] Simultaneous administration of ergota-mine tartrate with caffeine in Cafer-gone tablets has the advantage of reducing the usual dose of ergotamine necessary to abort these headaches.[3]

These measures will abort vascular headaches for 85-90% of sufferers:[1,3,5]

1. Advise the patient to re-organize his activities where possible.
2. Improve the general health of the patient.
3. Give 2 Cafergone tablets at first sign of impending attack and, if necessary, additional 1-tablet doses (up to 6) at half-hour intervals.

Literature, available on request, for further particulars on *Dosage Adjustment* and other points:
Reprints of recent reports.
Therapeutic brochures.
Chart: "Clinical Characteristics of Vascular Headaches."

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Each tablet contains, 1,000 international units of biologically assayed and standardized estrogenic hormones combined with 1/10 grain thyroid.

Also in tablets containing 5,000 international units each.

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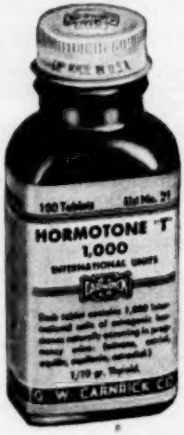

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ENDOCRINOLOGY

ACTH for Asthma

Even in severe cases, ACTH appears to be effective in relieving asthma. Of the 6 patients treated by Dr. Bram Rose and associates of McGill University, Montreal, 4 reported complete and 2 partial disappearance of all symptoms. All cases had persisted from three to eight years. The hormone was given intramuscularly every six hours for four to six days. Although 1 patient remained free from symptoms for a month after treatment, the exact length of the ACTH effect cannot be determined as yet.

Canad. M.A.J. 62:6-9, 1950.

STATISTICS

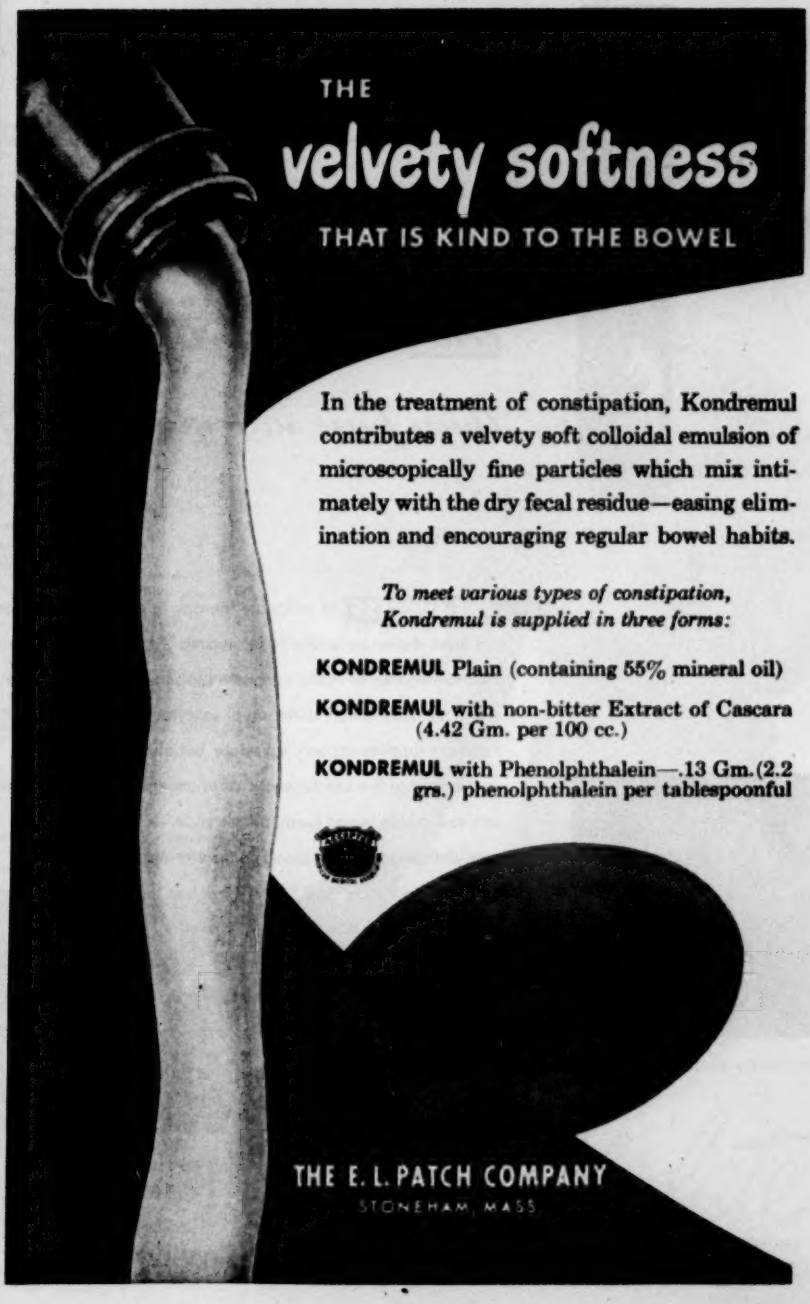
1949 Births

Only 1947's record-breaking number of births is greater than the total of 3,729,000 estimated for last year. The number of babies born in the four postwar years is nearly as great as the total for the five preceding war years. While first births have declined from the high level of 1947, the birth rate is maintained by an increase in second and third births, particularly among young mothers.

RESEARCH

Passano Foundation Award

The $5,000 award for medical research will be given by the Passano Foundation, Baltimore, this year to Drs. Edward C. Kendall and Philip S. Hench of the Mayo Clinic, Rochester, Minn., in recognition of their work in the development of cortisone and the application of the hormone to the rheumatic diseases. This is the second dual award since the Foundation was established.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In the treatment of constipation, Kondremul contributes a velvety soft colloidal emulsion of microscopically fine particles which mix intimately with the dry fecal residue—easing elimination and encouraging regular bowel habits.
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how can Pabalate provide better salicylate therapy than pure salicylate itself?

THE SUCCESS of salicylate therapy in rheumatic affections has been shown by authoritative reports[3,6] to depend largely o the maintenance of really adequate blood levels . . . frequently a difficult achievement under usual salicylate administration.

Pabalate supplies not only salicylate, but also a "booster" in the form of the antirheumatic para-aminobenzoic acid,[7] which acts to increase blood levels of salicylate.[1,2,4,5] In turn, the salicylate increases the blood concentration of the para-aminobenzoic acid.[2] Enteric coating helps Pabalate prever gastric irritation, insures optimal toleration.

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INDICATIONS: *Pabalate Tablets*—for adult patients with rheumatoid arthritis, acute rheumatic fever, fibrositis, gout and osteo-arthritis. *Liquid Pabalate*—for treatment of acute rheumatic fever or other rheumatic diseases in children and as a replacement for tablet salicylate medication; or for adults who prefer a liquid dosage form.

DOSAGE: Average adult dose: two tablets or teaspoonfuls, three or four times daily. Dosage should be adjusted upward if necessary. For children, dosage is proportional to age and severity of condition.

FORMULA: Each enteric-coated tablet or each teaspoonful contains Sodium Salicylate, U.S.P. (5 grs.) 0.3 Gm.; Para-aminobenzoic Acid (as the sodium salt) (5 grs.) 0.3 Gm.

SUPPLIED: Pabalate Tablets in bottles of 100 and 500. Liquid Pabalate in bottles of 1 pint.

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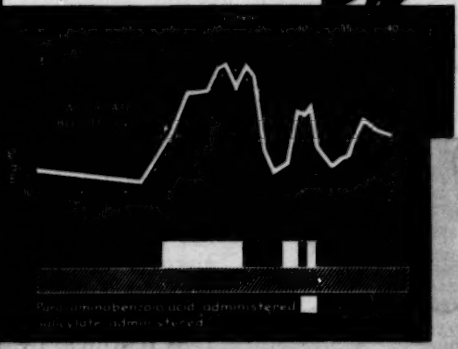
Para-aminobenzoic acid increases blood levels of concurrently administered salicylate.[2]



For treatment of rheumatic affections

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Robins

Washington Letter

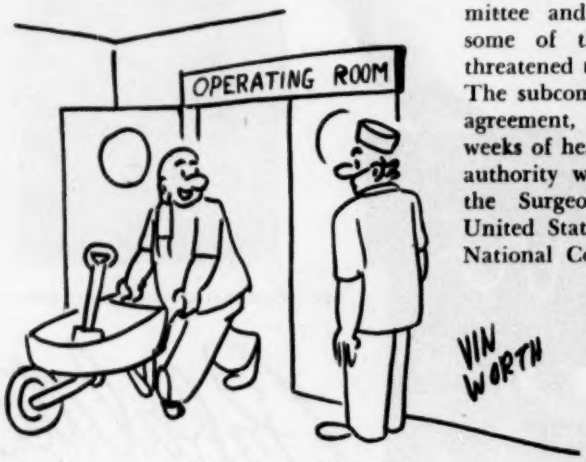
Congress Considers Many Bills Affecting Medicine

A number of bills affecting medicine, which a month ago were well in the background, now are making progress. In the last month or so the situation has shifted enough to suggest that this session of Congress may eventually compile a substantial record of legislation in this direction.

By far the most important is the National Science Foundation bill, which survived apathy, obstruction, and finally a coating of barnacles attached by the House in the form of national security restrictions. Without these, to which the Senate objected, the Foundation bill would have become law early in April. The Foundation will be a clearing-house of scientific information, as well as for scientific scholarships. By law, atomic energy research is ruled out, but all other areas of medical and scientific research should benefit greatly from the Foundation.

Some of the most bitter closed-hearing arguments of the session were waged during the last month over the bill on Aid to Medical Education. As originally drawn and approved by the Senate, this bill gave the surgeon general final authority to decide on the amounts of aid to each school, on the amounts of construction grants, and on other issues which could not be spelled out in the law.

A House subcommittee recalled the bill from the Rules Committee and tried to iron out some of the questions which threatened to kill the legislation. The subcommittee did reach an agreement, but only after three weeks of heated argument. Final authority was taken away from the Surgeon General of the United States and given to the National Council on Education for Health Professions, while at the same time the medical profession was given greater representation on the council.



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Comparative studies at various dosage levels show:

Side effects "much fewer and much less severe"*

Spring is the season when allergic rhinitis due to grass and tree pollens occurs, often simulating or aggravating the common "cold." For relief of catarrhal symptoms due to allergy, more and more physicians rely on

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as their first choice in antihistaminic therapy, because it is effective and exceptionally well-tolerated.

INDICATED in allergic rhinitis and allergic dermatoses.

*Schwartz, K. et al. Ann. Allergy 7:770 (Nov.-Dec.) 1949

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Advertisement

From where I sit *by* Joe Marsh

Handy and Easy Are Both Wrong

Handy Peterson and Easy Roberts got in quite an argument the other day over at Fred's Garage talking about the best spot to fish up at Green Lake.

"Opposite the old sawmill is the best spot," says Handy. But Easy "pooh-pooh's" him. "I've seen the biggest fish caught off Cedar Point," says Easy. "I've been catching them there for years."

Then Fred goes into his office and brings out the biggest mounted rainbow trout you ever saw. "Bet that was caught at the sawmill," comments Handy. "Cedar Point," says Easy. "Well," says Fred, "you're *both* wrong. I caught this baby right out in the middle!"

From where I sit, there are always two (or more) sides to every story. Let's live and let live in the true American tradition of toleration. Your opinion is worth a lot, but so is the other fellow's—whether it's on politics, the best fishing spots, or whether he likes a temperate glass of beer and you like buttermilk.

Joe Marsh

Copyright, 1950, United States Brewers Foundation

bill was not what the administration wanted. But it was better than no bill at all. And it was about the only bill that this Congress was prepared to grant.

Also the subject of a lot of discussion and some progress are the bills to provide a health program for schools and to help states in establishing local public health units.

Sponsors of the school health bill hoped that they had eliminated the public–private school issue by designating the benefits for "children of school age." However, this controversial issue again overtook the bill in midsession. Consequently, prospects for passage are not good. One compromise plan is to set up a school construction aid fund, for which only public schools would be eligible.

The local public health units bill has succeeded in moving along the legislative assembly line without arousing either enthusiasm or opposition. It should become law at any time, but perhaps with only a token appropriation for the first year.

On one other bill, administration strategy brought about an extensive public hearing. This is the proposal for a new federal administration to take over all hospital and medical work—Veterans Administration, Armed Services, and civilian.

Last year the President made a somewhat similar proposal, which he attempted to put into effect through a reorganization order. Congress exercised its veto right on this. This year, Mr. Truman ignored the medical services in his reorganization plan. Then, the same week that the reorganization orders were issued, a House committee called hearings on the United Medical and Hospital Administration bill. So anxious was

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the administration to center attention on the issue that it called these hearings on a bill offered by a Republican, Rep. Clair Hoffman of Michigan, although a Democratic bill also covered much the same ground.

Long before start of hearings, the American Legion served notice that it would fight the bill with all the strength it could muster. The Legion is determined to keep veterans' medical services in the Veterans Administration.

Sponsors of a united federal medical administration have failed before. They will try hard for action this time, but opposition from the Legion and other groups probably will make the task too difficult again this year.

AEC Scholarships

Because security requirements are strict, and also faulty, Atomic Energy Commission is prepared to announce that not enough applicants have qualified to use up available scholarship money. All scholarship recipients must undergo FBI investigation, but clearance for the sponsors who work with them on research is not required. Some sponsors of good scholarship material shy away from AEC for this reason, others because they don't approve of security investigations when the work does not involve restricted areas.

Blood Pool Study

Dr. Norvin C. Keifer, medical director for National Security Resources Board, is directing a study of possibilities and limitations of blood pooling in time of war. Working with him are a group of government and private organizations which are or would be concerned with the program.

Pinball Health Quiz

Public Health Service has just completed the first public exhibition, April 16-23, of a gadget that looks and acts like a pinball machine but that passes out health education at

"You men are all alike."

team for oral therapy

The daily administration of one or two Tablets MERCUHYDRIN® with Ascorbic Acid usually produces adequate diuresis in the cardiac patient whose water and electrolyte balance *has already been stabilized by parenteral mercurial diuretic therapy.* At this stage, the edema-free state — manifested by the unfluctuating basic weight — can be maintained with the tablets, either alone or supplemented by injections at appropriate intervals.

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a fast rate. The machine poses a written question with multiple-choice answers. After the operator has punched out his choice, the correct answer flashes on the screen. At the end of a series of questions, a score is indicated both numerically and in terms of "good," "poor," and so forth.

PHS experts now are attempting to work the same technic on a large screen to make it more attractive and useful for mass gatherings, such as county fairs and conventions. PHS now has just one such machine, which is not available for loan.

Military Medicine Budget

By July 1, start of the next fiscal year, Army, Navy, and Air Force medical departments will be operating on a new performance budget. Under this system, responsible officials will be able to tell at all times not only how much money is being spent, but where, and how.

At present, it is impossible to do more than estimate various costs even after the money has been spent. One reason for this is the fact that less than half the funds are accounted for in the medical department; the remainder of the cost is scattered among other budgets and impossible to locate.

Hospital Construction

Building of hundreds of hospitals scheduled for construction in all parts of the country will be delayed if the House appropriations committee is allowed to have its way. The committee reduced the appropriation from the current $150,000,000 to half that amount. The money goes as grants, which finance from one-third to two-thirds of the cost.

"Deficiency diseases tend to be multiple and it should not surprise you that people eating at the same table may all have deficiency diseases; the surprising thing is that one may have one deficiency disease, while another person may have an entirely different disease."[1]

1. Spies, Tom D.: Recent Progress In Nutrition, Postgraduate Med., 6:97, August, 1949.

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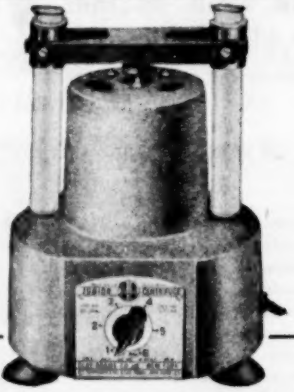

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THE PHYSIOLOGICAL BASIS OF MEDICAL PRACTICE *by* Charles H. Best *and* Norman B. Taylor. 5th ed. 1,330 pp. Williams & Wilkins Co., Baltimore. $11

MULTI-ENZYME SYSTEMS: FOUR SPECIAL LECTURES GIVEN TO UNIVERSITY COLLEGE, LONDON, IN MAY 1948 *by* Malcolm Dixon. 103 pp., ill. Cambridge University Press, London. 7*s.* 6*d.*

PHYSIOLOGIE MÉDICALE *by* R. Fabre *and* G. Rougier. 1,118 pp., ill. Librarie Maloine S. A., Paris. 2,500 fr.

A SHORT HISTORY OF PHYSIOLOGY *by* Kenneth J. Franklin. 2d ed. 147 pp. Staples Press, London. 10*s.* 6*d.*

PHYSIOLOGY OF HEAT REGULATION AND THE SCIENCE OF CLOTHING *edited by* Louis H. Newburgh. 457 pp., ill. W. B. Saunders Co., Philadelphia. $7.50

THE CHEMISTRY AND PHYSIOLOGY OF GROWTH *by* J. H. Northrop *et al.* Edited by Arthur K. Parpart, 293 pp., ill. Princeton University Press, Princeton, N. J. $4.50

TEXTBOOK OF PHYSIOLOGY *by* William D. Zoethout and W. W. Tuttle. 10th ed. 710 pp., ill. C. V. Mosby Co., St. Louis. $4.75

Pharmacology

ANTIBIOTICS: A SURVEY OF PENICILLIN, STREPTOMYCIN AND OTHER ANTIMICROBIAL SUBSTANCES FROM FUNGI, ACTINOMYCETES, BACTERIA AND PLANTS *by* Sir Howard Florey *et al.* 2 vols., 1,174 pp., ill. Oxford University Press, London. 168*s.*

THE CHEMISTRY OF ORGANIC MEDICINAL PRODUCTS *by* Glenn L. Jenkins *and* Walter H. Hartung. 3d ed. 745 pp., ill. John Wiley & Sons, New York City. $7.50

THE BRITISH PHARMACEUTICAL CODEX, 1949. 1,562 pp. The Pharmaceutical Press, London. 63*s.*

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CLINICAL NEUROLOGY *by* Bernard J. Alpers. 2d ed. 862 pp., ill. F. A. Davis Co., Philadelphia. $9.50

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EINFÜHRUNG IN DIE NEUROLOGIE *by* Oskar Gagel. 391 pp., ill. Springer, Berlin. 30.60 M.

DIE AKUTE POLYNEURITIS UND POLYRADIKULITIS *by* Herbert Teisner. 74 pp., ill. Wilhelm Maudrich, Vienna. 75 Sch.

Psychiatry

THE SEXUAL PERVERSIONS AND ABNORMALITIES *by* Clifford Allen. 2d ed. 346 pp. Oxford University Press, New York City. $5

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LEHRBUCH DER PSYCHIATRIE *by* Eugene Bleuler. 8th ed. 506 pp. Springer. Berlin. 26 M.

THE SEXUAL CRIMINAL: A PSYCHOANALYTICAL STUDY *by* J. Paul De River. 281 pp., ill. Charles C Thomas, Springfield, Ill. $5.50

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VARIETIES OF DELINQUENT YOUTH: AN INTRODUCTION TO CONSTITUTIONAL PSYCHIATRY *by* William H. Sheldon *et al.* 899 pp., ill. Harper & Brothers, New York City. $8

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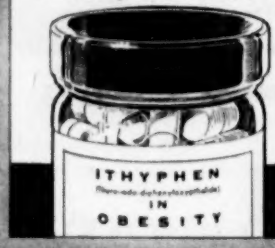

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An Evil of Specialization

They were two specialists on a holiday. The orthopedist after an appreciative look said to his companion, "The girls at these Florida beaches have beautiful legs, don't they?"

"I hadn't noticed," said his pal, "I'm a chest man, myself."—W.L.W.

"Comfy?"

Backed into It

It had been a breech presentation. On being asked what she would name the new boy, the mother answered, "Anthony."

"Oh," I said, "like Anthony Adverse?"

"Oh no Doctor," interceded a relative. "We are going to call this one Anthony Reverse."—B.A.

"In Prague," writes Ivan, "performing an abortion is called 'canceling a Czech.'"—T.Z.

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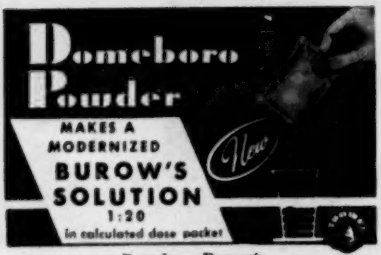

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He disappeared, and in a little while came back looking more worried than ever. When Dr. Smith came in the patient said in a loud whisper, "Doc, where is the *rest room*?"—F.B.

Some Like a Book

Two old ladies were discussing their physical ailments. Said one: "So your trouble is constipation. What do you take?" Said the other: "I just take my knitting."—W.L.W.

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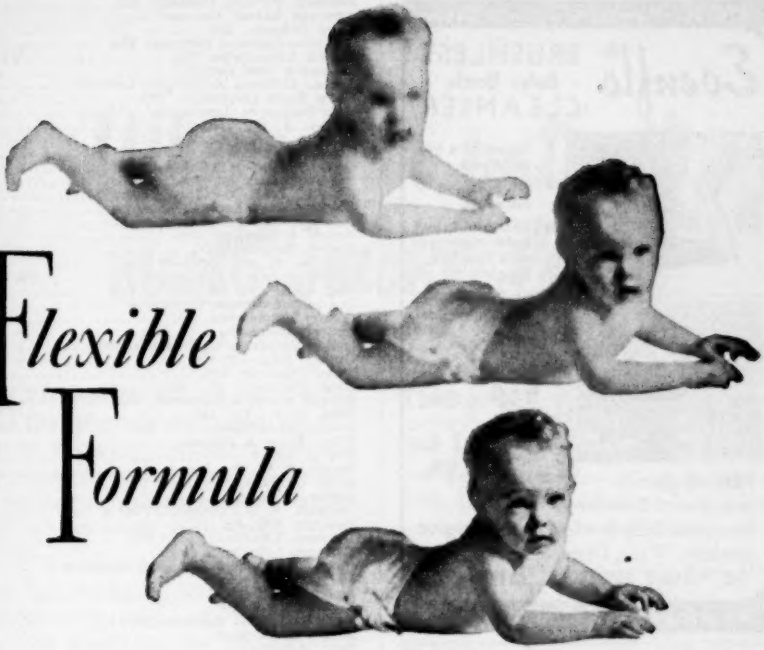

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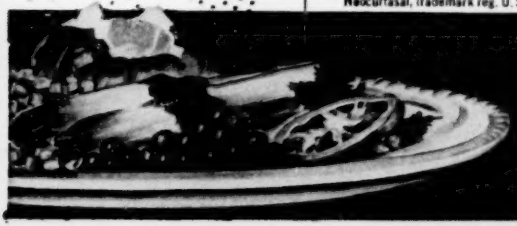

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Comprehensive literature on reques

1. Rogers, Max P.: J.A.M.A., May 21, 1
2. Wyatt, Bernard L.: Ann. West. Med. & Aug. 1949
3. Grimson, Marzoni, Reardon & Hendrix Surg., 127:5, May 1948

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